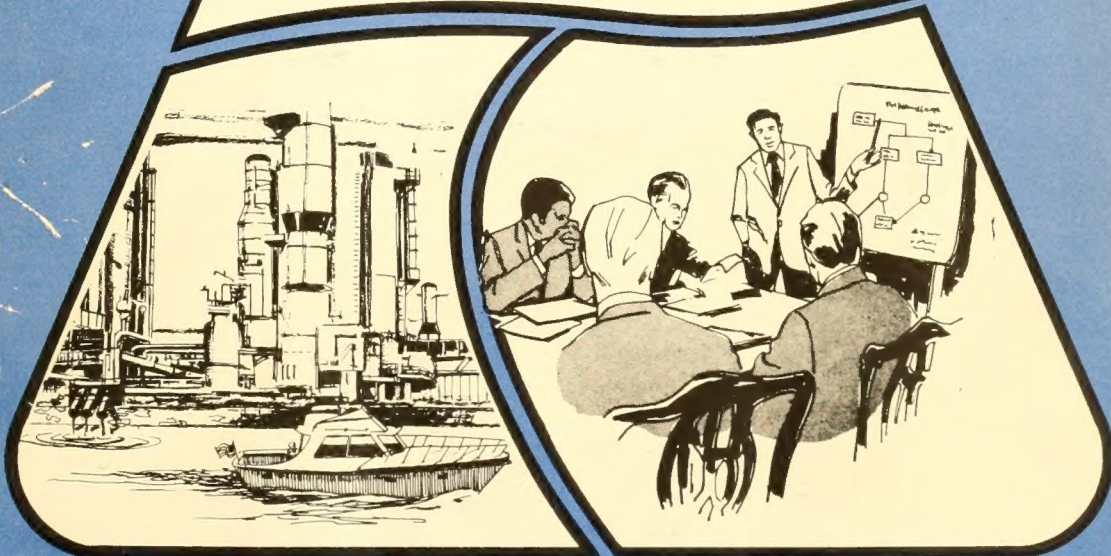


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THE NATIONAL ESTUARINE POLLUTION STUDY



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THE NATIONAL ESTUARINE POLLUTION STUDY

Volume III

A Report to the Congress



U. S. Department of the Interior • Federal Water Pollution Control Administration

NOVEMBER 3, 1969

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Part V

**DEVELOPMENT OF THE COMPREHENSIVE
NATIONAL PROGRAM**

INTRODUCTION

As decreed by the Congress in Section 5g of the Act:

"The report shall include . . . recommendations for a comprehensive national program for the . . . development of estuaries . . . and the respective responsibilities which should be assumed by Federal, State, and local governments and by public and private interests."

The recommendations are included in Part III of this report, and the following portion, Part V, contains the background material for the recommendations plus descriptions of the various governmental responsibilities.

The rationale for this development is as follows. To provide a basis for developing these recommendations and defining responsibilities, a volume of material was amassed on the views, suggestions, programs, and legislative authorities of all sectors of the National community -- Federal, State, and local governments and public and private interests. This background information was obtained through very diligent solicitations of all these sectors. The resulting material consisted of reports, correspondence, and personal communications which were analyzed and summarized to produce relatively brief overviews. The source information used to produce the overviews is being retained

separately from this report for future reference and updating.

These overviews, which are quite brief considering the original mass of information, are presented as the following chapters of this Part of the Report. The order in which they are presented is essentially the same as that used in the wording of the Act, that is, Chapter 1 is the Federal agencies; Chapter 2, the "State" agencies; Chapter 3, the local governments; Chapter 4, the compact (or interstate) agencies; and Chapter 5, the public and private interests. These overviews were related to those of other marine resource studies (Chapter 6) and then related to specific geographic areas to present a concrete overall view (Chapter 7) and finally summarized in the form of Conclusions (Chapter 8). In turn Chapter 8 provides the skeletal outline for the development of the recommendations enumerated in Part III of this Report, and Chapter 9 provides suggested guidelines for a management statute.

Chapter 1

ROLE AND PROGRAMS OF FEDERAL AGENCIES

This chapter describes the current Federal role and programs in the estuarine zone and identifies the needs to be met to provide for a stronger more effective Federal program.

The current Federal role as such, has grown over a period of many years and has as its basis the national interest which extends beyond State borders. The role is based on Federal legislation which itself has developed over a period of years to meet many specific needs seen and acted upon by Congress. It has also grown as one of concurrent jurisdiction with the States who exercise the primary authority in the estuarine zone--Even so the Federal role is a vital one and is essential to the preservation of national interests.

Broadly speaking these are:

- (1) the protection and development of the Federal interest in the natural resources of the estuarine zone,
- (2) commerce and navigation and,
- (3) national security.

SECTION 1. CURRENT FEDERAL ROLE IN THE ESTUARINE ZONE

The description of the Federal program that follows is a more complete picture of how the Federal role is implemented. In very brief form the role itself has come to be:

- (1) The provision of normal Federal projects such as navigation channels, flood control and protective works, aids to navigation, weather service including tides and currents, mapping and charting both for navigation and resources, and port security and shipping control.
- (2) Grants and loans to States and other entities for planning, acquisition and development, for research and study, and for facilities construction.
- (3) Technical advice and assistance through conference and consultation, mutual assistance projects, and joint projects and studies.
- (4) The preparation of broad studies and investigations, including inventories and data collection necessary to meet the requirements of Federal programs.
- (5) Acquisition and development of selected sites to preserve and protect them for the future.
- (6) The exercising of regulatory authority in accordance with current Federal law and statute. These authorities include the issuance of permits, licenses, and other regulations governing certain permissible uses or modification of

estuarine resources. They include also the enforcement of water quality standards and various other controls over pollution, and the enforcement of Federal law within the navigable waters of the United States.

(7) The exercise of coordinating activities, for the most part through close work with State counterpart organizations and at the headquarters level through committee and council work, routine daily business and memorandum of agreement.

(8) Granting Federal consent to interstate and international compacts and commissions.

(9) Assuring appropriate Federal performances under regional and international obligations for the management of flyways, fisheries resources, etc.

SECTION 2. THE FEDERAL PROGRAMS

To meet the requirements of the national interest and to carry out its role, the Federal Government has assumed fairly broad responsibilities in resource management, planning, regulation and control, and in many programs of technical and financial assistance to the States and the subdivisions. The description of the Federal programs that follows will show how this has developed and how these programs currently meet Federal responsibilities.

In describing the current Federal programs in the estuarine zone it is important to note that the greater part of these programs is of much broader scope than just that of the estuarine zone, and thus the activities reported herein are generally portions of larger programs which overlap and crossover the estuarine zone. Because these programs are of long-standing importance to the development and preservation of the Nation's resources and to the promotion of its commerce and industry they should not be fragmented or segmented by arbitrary geographic dividing lines; nevertheless, this description will confine itself as closely as possible to those parts of the programs relating to the estuarine zone, with the possible risk of appearing incomplete at times.

FOUR GENERAL CATEGORIES OF PROGRAMS

Categorization of the multitudinous Federal activities in the estuarine zone cannot be clear-cut as there is a continuous series of interlocking

activities and concurrent jurisdictions. Nevertheless, four general categories become apparent when the overall activities are viewed. These are: (1) those activities and programs having a direct and significant operational effect; (2) programs or activities having indirect or related effects; (3) activities primarily of a research and study nature; and (4) activities of a planning and coordination nature.

CATEGORY ONE PROGRAMS HAVING DIRECT AND SIGNIFICANT EFFECTS

Into category one have been placed the programs of the Department of the Interior, the Department of Commerce, the Civil Works Program of the Corps of Engineers, and the Department of Transportation, as all these in themselves have a direct and major effect on the use of the estuarine zone.

Department of the Interior

By virtue of the numerous activities of the bureaus and offices in the Department of the Interior, the Department, in essence, is the resource manager of the estuarine zone. This applies to both the living and nonliving marine resources and to a slightly lesser extent the related land resources. This is well demonstrated in the description that follows.

Interior's estuarine programs are planned and managed to meet expanding national needs for material, aesthetic, and environmental resources

and qualities afforded by the estuarine areas. Programs in support of objectives provide for aggressive leadership in research and management. For the most part the programs also encourage and complement appropriately designed estuarine activities of other Federal agencies and State and local governments.

Bureau of Commercial Fisheries

Concerned largely with coastal waters and the open ocean, the Bureau of Commercial Fisheries works with nature as yet little affected by human management except for those anadromous species which use the estuaries and migrate into fresh water to spawn. It has the responsibility to ensure an adequate, dependable, and diverse supply of fish and shellfish products of good quality; encourage optimum use of estuarine living resources; and contribute to man's understanding and control of estuarine living resources and their environment. To achieve these objectives, the agency conducts research on estuaries, estuarine problems, or estuarine-dependent species of fish at more than half of its twenty biological laboratories.

The Bureau of Commercial Fisheries and the Bureau of Sport Fisheries and Wildlife have, after more than a decade as a service, recently formed several interbureau committees on such matters of common interest as estuaries, anadromous fish, and conflicts between commercial and sport fishermen.

Task forces on ad hoc basis are constantly being formed for special interbureau purposes. These developments and other basic responsibilities of longer standing place the Department of the Interior in an expanding role of leadership and responsibility in estuarine research, planning, and management.

Bureau of Sport Fisheries and Wildlife

In the conservation of estuarine fish and wildlife resources and the preservation of estuarine habitat, the Bureau of Sport Fisheries and wildlife has a very substantial program. Under a variety of legislative authorities the Bureau activities include investigations and recommendations for the preservation and enhancement of fish and wildlife resources in connection with waterfowl population statistics and of regulations pertaining to waterfowl; Federal aid to the States for acquisition of wetlands, research on fish and wildlife, and access and development of facilities for fishing and hunting; training of biologists and dissemination of technical advice; conservation education: and pesticide monitoring.

The Bureau is also charged with the second estuary study underway in the Department, the National Estuary Protection Act (PL 90-454). This Act expresses the intent of Congress ". . . to recognize, preserve, and protect the responsibilities of the States in protecting, conserving, and restoring the estuaries in the United States."

This legislation directs the Secretary, in cooperation with the States and with other Federal agencies, to conduct a detailed inventory of the estuaries of the Nation. Such inventory and analyses would be the base for determining appropriate means and measures of preserving or restoring particular areas, including legislation.

Coordination of the two estuary studies has been accomplished through the Office of Marine Resources, in accordance with Secretarial Order Number 2908, approved in October 1968. In order to avoid duplication of effort the Estuarine Protection Act Study will use the Estuarine Inventory being developed by the National Estuarine Pollution Study.

Of the 312 units in the National Wildlife Refuge System, 78 are coastal. These coastal refuges have a combined shoreline of more than 500 miles and an area of more than 18 million acres, of which 682,000 acres are identified as estuarine. As administrator of these areas, the Bureau is a potent factor in the conservation of these estuarine resources. An additional potent factor in the conservation of estuarine resources is the Bureau's responsibility to review and comment on Corps of Engineers permits as required by the Fish and Wildlife Coordination Act.

Bureau of Land Management

While the Bureau of Land Management is the designated management agency of public domain lands, a sizeable portion of these lands

are along the California and Oregon coasts. The Bureau plays strictly a management role, and, as such, has no authority to acquire any additional lands. It is the Nation's largest land manager.

Bureau of Mines

The Bureau of Mines is oriented to research and information services. In its estuarine related programs it seeks to develop the technology necessary to minimize the adverse affects associated with mineral recovery. They include a Mineral Resource Evaluation Study and the development of marine mineral mining technology. The Bureau has jurisdiction over that part of the Solid Waste Program which involves materials resulting from mineral extraction.

Bureau of Outdoor Recreation

An examination of the Bureau of Outdoor Recreation program indicates a central role in promoting Federal-State cooperation and coordination in planning the acquisition and development of both existing and proposed new estuarine areas devoted to public recreational use. Although it administers no lands, it administers the Land and Water Conservation Fund Act of 1965 (PL 39-578) which other agencies--Federal, State, and local--make use of in their land programs. The Act provides grants to the States for the planning, acquisition and development of outdoor recreation areas and facilities, and to certain Federal agencies for the acquisition and development of outdoor recreation areas and facilities.

The Bureau also participates in comprehensive river basin planning, water resource project planning, and reviews reports related to such activities. The Bureau and the National Park Service also work together on area planning, often with the participation of the Bureau of Sport Fisheries and Wildlife. Emphasis is given to assure that adequate consideration is accorded to the estuarine environment.

Federal Water Pollution Control Administration

Created by the Water Quality Act of 1965 (PL 89-234) and significantly expanded in powers and funding through the Clean Water Restoration Act of 1966 (PL 89-753), the Federal Water Pollution Control Administration has a singularly complex and essential program.

In carrying out its pollution control program, this Agency conducts a series of major programs in the estuarine zone. Briefly, these programs include Comprehensive Water Quality Management Planning, Technical Services, Construction Grants Program, Enforcement, Water Quality Standards and Research.

The Comprehensive Water Quality Management Planning Program in the estuarine zone involves the coordination of the in-house water pollution control planning efforts with water resources planning conducted by other Federal, State, and interstate planning agencies to ensure adequate consideration of water quality factors. It also provides the means for systematic evaluation of multiple resource needs to meet future demands. This includes development of programs relating to the

control of water pollution in the estuarine zone. Water Quality Management Planning Grants are made to State and local governments. Under Executive Order 11288, FWPCA carries out certain review and consultation responsibilities for the Department in connection with wastes from Federal activities. The Corps of Engineers dredge and fill permits on estuarine and coastal areas, are reviewed in regard to effects on water quality.

The Technical Support Program operates water quality surveillance networks and sampling programs (in cooperation with the Geological Survey) and conducts special studies on the character, effects and abatement of water pollution including that related to vessel wastes, dredging activities, thermal discharges, municipal and industrial waste discharges, land drainage and salt water intrusion. In addition, the Program operationally administers the Oil Pollution Act of 1924, as amended, and develops and coordinates the implementation of the National Multiagency Oil and Hazardous Materials Pollution Contingency Plan and the supporting regional plans.

Enforcement proceedings are conducted to abate pollution of coastal waters and also when there are violations of water quality standards. Some 14 enforcement proceedings have been carried out in the estuarine areas.

The research and development program provides for increasing the knowledge and techniques for monitoring water quality in the estuarine

zone, for recovering those areas damaged by pollution through a variety of means, and for determining the effects of water pollution on estuarine life. The Federal Water Pollution Control Administration has an extensive Research and Development Program involving the detection, control and clean-up of oils spilled into harbors, rivers, and estuaries.

Recently accomplished activities of the Federal Water Pollution Control Administration include:

- (1) the partial or complete approval by the Secretary, of interstate water quality standards for the fifty States, three territories, and the District of Columbia;
- (2) completion of the Oil Pollution Report and a completion and implementation of the National Multi-Agency Oil and Hazardous Materials Contingency Plan; and
- (3) in conjunction with the Geological Survey, the Agency is currently using STORET as a data storage and retrieval system. Its use will expand as funds permit.

Geological Survey

The Geological Survey has been describing and interpreting the environment for nearly a century, a prerequisite for intelligent efforts to shape, control, or preserve it. It maps the physical, hydrologic and cultural features of the land and by aerial photographs provides a record of changes over time, thus, forming a basis for land-use planning and interpretation. This structural and historical geology of the Nation provides a guide to useful minerals and fuels, and is basic to an understanding of soils. Reliable knowledge about water is necessary for inland navigation, flood control, power development, irrigation, municipal and industrial water supplies, pollution abatement, fish and wildlife, and recreation. Geological research plays a supporting role for many Federal agencies, State programs, and private enterprises on land, at sea, and in space. It should be noted that much of the survey's activity is of a research nature and some of it is of a planning and coordinating nature.

Recent program accomplishments include the changes made in Outer Continental Shelf (O.C.S.) rules.

On February 17, 1969, an amendment was published in the Federal Register making the pollution prevention section of the Geological Survey (O.C.S.) regulations more restrictive. It also

established that companies operating on the Shelf shall be liable without proof of fault for pollution resulting from their operations. These particular changes apply to operations on the entire Shelf all around the country. On March 21, the Secretary announced that certain California O.C.S. Orders were changed. (O.C.S. Orders are issued by Geological Survey Regional Oil and Gas Supervisors and they apply only to those parts of the Shelf within the specific region under each supervisor's jurisdiction.) These changed Orders provide for more strict control of oil drilling and production operations in all Federal waters off the entire State of California. Also, on March 21, the Secretary directed that a two-mile wide permanent ecological preserve be established off Santa Barbara immediately seaward of the three-mile limit of the State of California. He also directed that all unleased areas south of this permanent preserve will be held as an additional buffer zone where no oil drilling or production operations will be permitted.

Bureau of Reclamation

Although the Bureau programs in the seventeen western States have little direct involvement in the estuarine zones there is opportunity for its unstream water resource development activities to have long range impacts downstream on estuarine resources. The downstream influences of these projects are being considered and are of importance to the Department's interest and responsibility in the estuarine zones.

National Park Service

The preservation of marine life and environments and the provision for marine-related recreational activities are major considerations in the National Park Service's administration of twenty-four areas along the Nation's seacoast and along the shores of the Great Lakes. Fifteen of these areas are national parks and monuments where resource protection is a major management objective; seven are national seashores located along the Atlantic, Gulf, and Pacific Coasts and two are national lake-shores located along the Great Lakes where outdoor recreation is a primary management consideration.

In addition, twenty-eight units within the National Park System are historical areas found along our coastlines. Total length of shoreline in these 52 areas exceeds 1,870 miles.

The service's combined role in marine-related areas is to preserve and manage natural, scenic, historical, and scientific features of these areas, to interpret these features for park visitors, to provide and maintain facilities and services necessary for park visitors to safely enjoy compatible recreational activities, and to provide access to waters and beaches. The Service, also, participates in comprehensive river basin and water resources project planning and in review of project proposals and permit applications.

Office of Saline Water

The primary objective of the Saline Water Conversion Program is to develop practicable low-cost methods of producing fresh water from sea and other saline waters. The research and development program is conducted by means of research and development grants and contracts awarded to individuals, universities, private research organizations and industrial firms, and other government agencies. Estuarial waters are one source of saline waters for desalting. Disposal of waste brine from a large desalting plant may be a problem in relation to environmental conditions in certain estuarine situations from the viewpoint of increases in salinity and temperature. The Office of Saline Water brine disposal research program is directed to determining any detrimental effects and means of alleviating them so that the economic production of fresh water by desalination can be continued without imposing stresses on the environment.

Office of Water Resources Research

The Office of Water Resources Research, authorized under the Water Resources Research Act of 1964 (PL 89-404) provides a major benefit to the Nation. It seeks to stimulate, sponsor, and supplement present programs of research and training in the field of water and of resources that affect water. This is done through grants and contracts with academic and private

institutions, private firms, individuals, and public agencies through operations in 50 States and Puerto Rico. Most of the studies are on water supply augmentation and conservation, while others are concerned with water quality management and protection, water quantity management and control, water resources planning, and the hydrological cycle.

In summary, Interior's programs cover most of the major resources and uses of the estuarine zone, including the rapidly increasing recreational use and the unquantified aesthetic values.

The Department of Commerce

The Department of Commerce is another organization whose programs have a direct and significant effect on the beneficial uses of the estuarine zones. Because estuarine zones are used for sea commerce, the Department of Commerce, and especially the Maritime Administration and the Environmental Science Services Administration (ESSA), are concerned with these areas. Action, primarily is directed toward collection of navigational data and the development of harbor and port facilities. The Office of Business Economics, the Bureau of the Census, and the Economic Development Administration are indirectly involved in these efforts.

The Maritime Administration has statutory responsibilities for promoting and encouraging the development of an American flag merchant marine and U.S. ports and related transportation facilities in connection with waterborne commerce. In recent years, the Maritime Administration has become increasingly aware of the detrimental effects of harbor pollution and is involved in activities to solve this problem. With the advent of nuclear powered vessels and the resulting radioactive discharges, the Administration has worked towards the establishment of stringent standards to prevent radioactive contamination of harbor waters. Contracts for the development of devices to detect and prevent oil pollution of harbors have been let; the results of this research have been published. This agency is also involved in comprehensive research studies with several other agencies to investigate the requirements of a national system of ports. The proposed study would consider long-range U.S. port and transportation needs, including detailed analysis of, recommended solutions for, and specific problems generated by rapidly changing shipping technology such as "the supercarrier." In the process important interrelationships between transportation, urban renewal and estuarine resource developments could be identified.

ESSA provides a direct and important service through its mission of mapping and charting the coasts and harbors of the United States and its territories. In addition, it provides the adjunctive services of tide and current information, marine weather service, hurricane and tsunami warnings and various other supplemental services relating to marine safety and navigation. Its recently inaugurated flushing prediction service will grow in value to the beneficial use of the estuarine zones.

The Economic Development Administration although indirectly involved in estuary related programs does provide assistance in comprehensive planning affecting the estuarine zone and in support to actual projects in the zone. For example the Coastal Plains Regional Commission establishment pursuant to the Public Works and Economic Development Act of 1965 has as an important segment of its activities a Marine Resources Program designed to stimulate growth and use of marine resources in the Region. The agency itself has contributed to numerous projects within the coastal area.

In brief summary the Department of Commerce programs provide essential services in the estuarine zone contributing primarily, but not entirely to the commercial use of the zone.

Corps of Engineers

Perhaps the organization that has the greatest direct physical effect on the estuaries is the Corps of Engineers operating under the Department of Defense.

Through its civil works program it literally maintains and administers the navigable waters of the United States. Its programs in the estuarine zone include:

- (1) provision of channels, basins and protective works;
- (2) control of dredging, filling, excavation and construction in navigable waters through issuance of permits;
- (3) development of areas for disposal of dredged material during construction and maintenance of navigation projects; and
- (4) issuance of permits regulating the discharge of industrial and other wastes into navigable waters.

Other important Corps estuarine-related programs include:

- (1) removal of wrecks, aquatic vegetation, debris, drifts, and other obstructions from navigable waters,
- (2) restoration of beaches;
- (3) construction and maintenance of small boat harbors;
- (4) providing fishing sites on piers and breakwaters;
- (5) fish and wildlife conservation;

- (6) development of offshore sand sources for beach restoration;
- (7) low flow augmentation;
- (8) conduct of design and research studies of estuaries at Corps laboratories;
- (9) administration of Federal laws protecting and preserving U.S. waters; and
- (10) flood and hurricane protection.

In addition, it must be noted that the Corps of Engineers programs of dam building, flood control and river clearance upstream from the estuarine zone have very definite effects on the fresh water inflow to the estuary. Its study programs cover many facets of estuarine research, including physical, chemical, biological, and ecological factors. The comprehensive study of the Chesapeake Bay authorized in 1965 but not yet undertaken, is a typical example of Corps activity in this area.

Department of Transportation

The Department of Transportation is the fourth Federal agency whose programs have a direct and significant effect on the resources and the use of the estuarine zone.

Under this Department the Coast Guard performs a series of service activities of essential importance to the beneficial use of the estuaries. These include:

- (1) the enforcement of Federal laws within the navigable waters of the United States;
- (2) port security with emphasis on the control and movement of vessels and on the safe movement of hazardous cargoes;
- (3) maintenance and operation of aids to navigation and regulation and administration of bridges over the navigable waters;
- (4) search and rescue - assistance to persons operating vehicles and aircraft in distress;
- (5) administration of the Federal Boating Act of 1958; and
- (6) icebreaking.

In regard to the resources of the estuarine zone, those Coast Guard activities having the greatest effect are the enforcement activities concerned with oil pollution control, as provided under the Oil Pollution Act of 1924, as amended, and its attempts to find ways to ease or eliminate the unavoidable pollution. The Coast Guard now has an active research program in oil pollution abatement, containment, source control, and recovery of oil spills. Its role in the Ocean Data Buoy System Program could assist in inshore pollution monitoring at a later date.

Also under the Department of Transportation, the Federal Highway Administration's Bureau of Public Roads is concerned with estuarine

resources because many of its highways cross and provide access to estuaries. The Federal Aviation Administration's activities in the construction and operation of airports encroach upon the estuaries and have impact on the surrounding environment.

CATEGORY TWO PROGRAMS HAVING INDIRECT OR RELATED EFFECTS

In this category are the programs and activities of the Department of Housing and Urban Development, Agriculture, and Health, Education, and Welfare. In general, certain of their programs do have direct and beneficial effect in the estuarine zone but they have it indirectly, a result of programs directed towards the land rather than the water areas of the estuarine zone.

Department of Housing and Urban Development

The Department of Housing and Urban Development provides direct financial and technical assistance to States, metropolitan, and local areas for comprehensive planning, housing and other aspects of urban and metropolitan development. Much population growth and development is near estuarine zones, and assistance programs for the planning, development and use of estuaries and adjacent properties have significant impact on these zones.

Comprehensive planning grants provide assistance to many levels of government for the preparation of comprehensive plans for land use, facilities and the use of natural resources. Comprehensive planning

on an areawide basis is required as a condition for funding many facility grant programs which directly affect estuarine zone management. Grants for water and sewer facilities, for acquisition of sites for public uses, and for the purchase of open space for parks, recreation and conservation can all contribute to better use of waterfront areas and can aid in more effective estuarine management.

The National Flood Insurance Program, authorized by the Housing and Urban Development Act of 1968, requires land use provisions to restrict future development of flood-prone lands. By June 30, 1970, permanent land use and control measures consistent with land management must be adopted by State or local areas before insurance coverage is provided. Title I of the Housing Act of 1949 provides loans and grants for urban renewal or redevelopment of waterfront areas. The Open Space Program can help protect urban wetlands and develop or preserve undeveloped, waterfront areas for recreational use. Newer programs, such as Model Cities, can assist estuarine management by providing a coordinated program to improve the urban environment. The New Communities provision of the 1968 Act will encourage the private development of new communities by guaranteeing the financing by developers. These can contribute toward estuarine management through the location and design of land use patterns so as to reduce pollution loads and improve recreational facility development.

Department of Agriculture

The Department of Agriculture contributes to the overall management, use, and preservation of the estuarine system. The particular program concern of the Department is land use, soil and water conservation, erosion prevention practices, and certain measures involved in placing and maintaining these lands in a stable and productive condition. As erosion and the volume of sediment is diminished, the estuaries can more effectively perform their normal biological roles. Its areawide sewer and water planning grants and its sewer and water facilities loans and grant, contribute to the abatement of pollution to the extent that they are adjacent to the estuarine zone.

Under Public Law 566, Watershed Projects provide effective control and stabilization of sediment source areas that could otherwise contribute harmful deposits into estuarine areas.

The Forest Service has Federal leadership in the forestry phases of watershed protection. Twelve National Forests, which involve lands that drain directly into estuarine areas, have land management activities that directly affect the estuarine resource.

Research directed towards pesticide residues in silt and the use of brackish water for irrigation will contribute to an increase in knowledge of the estuaries, their uses and problems.

Here again is an example of programs directed towards land use and the preservation of that land contributing also to the preservation of the estuarine zone. In that they do so, the planning of such activities should be related to any comprehensive estuarine management plan.

Department of Health, Education, and Welfare

The relationship of this Department to estuarine zones and management includes its concern about the fitness or suitability of these areas for human use and the resulting impact on human health and well-being. The Public Health Service of the Department has jurisdiction over its estuarine-related activities through the Consumer Protection and Environmental Health Service, namely the Pesticides and Shellfish Sanitation Programs of the Food and Drug Administration and the Bureau of Solid Waste Management, Water Hygiene and Radiological Health of the Environmental Control Administration.

Food and Drug Administration activities include the evaluation of food additives and pesticides in seafoods, conducting studies on flora and fauna of certain estuaries, the development of fish protein concentrate, ecological studies of clostridia (botulism), toxicity, and carcinogenicity of smoked fish, salmonella in fishery products, virus in marine foods, and toxicological screening. The Food and Drug Administration is also responsible for administering the National Shellfish Sanitation Program, which is primarily

concerned with the sanitary production of safe shellfish from high quality estuarine waters.

The Bureau of Water Hygiene conducts studies on health aspects of the water quality of the marine environment as it relates to shellfish production, recreation and water resources planning.

The Bureau of Radiological Health conducts projects on reactor effluent radionuclides in marine ecosystems, radiological surveillance of marine environments, and the passage of radio-elements through sub-tropical marine environment and biota.

The Bureau of Solid Waste Management is surveying through contract, the ocean disposal problem and expects to produce pollution potential data. A research project in Boston, Massachusetts, is studying the effect upon the marine ecosystem of incinerator residue.

CATEGORY THREE RESEARCH AND STUDY PROGRAMS

In Category Three are those agencies whose activities in the estuarine zone are primarily research in nature; namely, the National Science Foundation, the Smithsonian Institution, and the National Academy of Sciences - National Academy of Engineering. The programs and activities of all three of these organizations are extremely broad and it is only as their activities relate directly to the estuarine zone that we briefly describe them here.

The National Science Foundation

The National Science Foundation supports scientific research and education in the sciences, including estuarine-related disciplines. It has funded the development of marine and atmospheric research facilities. It has also sponsored a broad spectrum of research activities, and has supported the education of environmental scientists of all kinds. The agency was also given additional authority by the National Sea Grant College and Program Act of 1966 (PL 89-688). Under the provisions of the Act, the National Science Foundation acts to support applied research by establishing an Office of Sea Grant Programs and by preparing policy guidelines for use by grant applicants. Several Sea Grant programs have been directed largely towards the estuaries.

The Smithsonian Institution

The Smithsonian Institution relates generally to the ecological, biological and geological study, preservation and educational aspects of fauna, flora, and sediments in estuarine areas. It depends upon the accumulation and analysis of adequate biological and environmental data to predict the impact of environmental modifications on the estuarine biota. The modifications must represent improvement rather than degradation. It operates an Oceanographic Sorting Center for the processing of aquatic, biologic and geologic samples. It develops interdisciplinary conferences, such as on pollution problems

in New York Harbor. It conducts studies on subjects ranging from sedimentation and beach erosion to the distribution and abundance of marine plants and animals. The agency is involved with several research facilities with capabilities in the area of estuarine ecosystems and in various kinds of tropical research.

National Academy of Sciences--National Academy of Engineering

The National Academy of Sciences (NAS) and the National Academy of Engineering (NAE) are twin organizations composed of distinguished scientists and engineers dedicated to the furtherance of science and engineering and their uses for the general welfare. Although not government agencies, the academies enjoy close relations with the Federal Government from which they hold Congressional charters. Each charter specified, "the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art, the actual expense of such investigations, examinations, experiments, and reports to be paid from appropriations which may be made for the purpose, but the Academy shall receive no compensation whatever for any service to the Government of the United States."

The NAS and the NAE contribute to the development of knowledge of the Nation's estuaries through their respective committees on oceanography (NASCO) and Committee on Ocean Engineering (NAECO). The most recent contribution of the NASCO and NAECO, acting in

concert, has been the conduct, at the request and under the sponsorship of the Federal Water Pollution Control Administration, of a meeting: "Coastal Waste Management," held in June 1969. This session is described elsewhere in this report; the final resultant document will be published by the academies early in 1970. The purpose of this meeting was to examine the following questions:

- (1) What is known about the impact of wastes on the oceans?
- (2) What is known about the magnitude of the impact the marine environment can tolerate?
- (3) What is our present capability to predict future impact of wastes on the coastal ocean environment?
- (4) What investigations should be undertaken in order to improve our ability to handle the above questions?

The National Academy of Sciences and the National Academy of Engineering have a history of significant contributions to knowledge necessary to develop a sound system of management for the estuaries and will continue to offer valuable guidance in the future by bringing together in appropriate groups the most competent scientists and engineers in the country to deal broadly with scientific and engineering problems in estuaries and to exchange information in the furtherance of research.

CATEGORY FOUR
PLANNING, COORDINATING, AND LICENSING PROGRAMS

These are the Government agencies whose functions lie generally in the field of planning, coordinating or licensing. Their activities as they relate to or affect the estuarine zone are briefly described.

The Water Resources Council

The Water Resources Council, established in the Water Resources Planning Act of 1965 (PL 89-90) awards planning grants to the States for their comprehensive planning in the development of water and related land resources, including estuarine resources. This planning considers that the Nation's estuaries and coastal areas are inseparably related to their watersheds and to the rivers which supply them with fresh water. These watershed relationships determine the characteristics of estuaries and coastal areas and influence their usefulness to man. Among the many objectives of such planning is a consideration of appropriate regional institutional arrangements necessary to implement the comprehensive plans. It also advises the President on national water policy, maintains a continuing assessment of national water supply needs, and coordinates the activities of Federal water resources agencies. The Council also oversees the execution of congressionally authorized comprehensive water and related land resources planning projects for specific river basins. Existing Federal-State river basin commissions under the aegis of the Council are organized and functioning in 15 of the 30 coastal States, and alternative Federal-

State planning coordination mechanisms are organized in all the remaining coastal areas under the general leadership of the Water Resources Council.

National Council on Marine Resources and Engineering Development

The Marine Resources and Engineering Development Act of 1966 (PL 80-454) established two complementary bodies: The Commission on Marine Science, Engineering and Resources and the National Council on Marine Resources and Engineering Development. The latter provides for the development, encouragement, and maintenance of a comprehensive long range and coordinated national program in marine science. The national program applies to oceanographic and scientific endeavors and disciplines, engineering and technology in and with relation to the total marine environment. The report of the Commission with respect to multiple use of the coastal zone will be discussed in some detail in a later chapter.

The Atomic Energy Commission

The interests and operations of the Atomic Energy Commission (AEC) regarding the estuarine zone lie almost completely in the effects of radiological and thermal wastes as pollutants in estuarine zones. Research programs and projects of the Commission most directly related to the estuarine system are conducted through contracts, with an emphasis on nuclear safety. Such broad programs include:

- (1) Disposal of radioactive wastes--their effects and movements through estuarine zones;
- (2) accumulation of radionuclides in wildlife and sediments of these zones and their relation to the ecology of the zone;
- (3) use of radionuclides in pollution study and the detection of pollution, and in some cases, the abatement of pollution; and
- (4) thermal effluents from atomic plants.

The AEC licenses nuclear plants from the standpoint of radiological safety only. This important licensing authority unfortunately does not now require consideration of other environmental effects, particularly those of thermal effluents.

Federal Power Commission

The Federal Power Commission is an independent agency operating under the Federal Power Act, the Natural Gas Act, and other statutes. It is concerned principally with the regulation of the interstate aspects of the electric power and natural gas industries. Some of the regulatory activities involve power and natural gas facilities located in estuarine zones.

Under the authority of the Federal Power Act, the Commission issues licenses for the construction and operation of nonfederal hydroelectric power projects on navigable waterways, on any stream over which

Congress has jurisdiction where the project affects interstate commerce, or on public lands or reservations of the United States; it investigates and prepares reports on the water and power development of the rivers of the United States; it collects data on the electric power industry; and it studies plans for reservoir projects proposed to be constructed by Federal agencies and makes recommendations concerning the facilities to be installed for hydroelectric power development. That Act directs the Commission to promote and encourage the voluntary interconnection and coordination of electric utility systems to assure an abundant supply of electric energy throughout the United States with the greatest possible economy and with regard to the proper utilization and conservation of natural resources.

SECTION 3. A SYNTHESIS OF FEDERAL PROGRAMS AND THEIR MEANS OF COORDINATION

The Federal programs in the estuarine zone are widespread and quite obviously have far-reaching effects. They must support the national interest and meet numerous Federal responsibilities. In addition, they have a considerable effect on State and local programs. To be effective the various Federal programs should complement each other, should avoid duplication and should be well coordinated with one another and with the corresponding State-level programs.

In order to present a reasonably clear synthesis of the Federal programs, the accompanying Table V.1.1 presents a summary of major Federal activities in six different estuaries. For each Department and for each of the selected estuaries there are listed the routine activities or programs of the Department and then the additional or special activities in that particular estuary. The routine activities generally stay the same for each estuary and are most often those imposed by statute or results of long standing programs. The special activities are an attempt to note specific projects, studies, etc., of current or recent nature in individual estuaries. Means of coordination currently in use are listed in the final column. For purposes of simplicity the table presents only the programs having direct and important interest or related effects (categories one and two). This is not to derogate the importance of other activities but only to provide for simpler presentation.

TABLE V.1.1
Summarization of Federal Activities

Federal Department	Delaware Bay	Penobscot Bay	Chesapeake Bay
<u>Commerce</u>	<u>Routine Activities</u> Mapping and charting, environmental prediction Port Development <u>Special Activities</u> None reported.	Applies to all six estuaries <u>Special Activities</u> Special Estuarine flushing studies and predictions.	<u>Special Activities</u> None reported.
<u>Transportation</u>	<u>Routine Activities</u> All Coast Guard services, i.e., Law enforcement, aids to navigation, rescue, boating safety, port security, control of shipping. <u>Special Activities</u> None reported.	Applies to all six estuaries <u>Special Activities</u> None reported.	<u>Special Activities</u> None reported.
<u>Corps of Engineers</u> (Dept. of Defense)	<u>Routine Activities</u> Maintenance of Navigable waters. Control of dredge and fill by permit. Harbor pollution. Harbor construction. <u>Special Activities</u> Scale hydraulic Model (Vicksburg). Study scheduled on deep draft channel.	Applies to all six estuaries <u>Special Activities</u> Deep draft channel study.	<u>Special Activities</u> Special study of the Chesapeake Bay authorized by Act of Congress 1965.
<u>Interior</u>	<u>Routine Activities</u> Permit review in conjunction with Corps of Engineers permit activities. Land and Water Conservation Fund Grants, Sewage and Construction Grants, various Planning and Management and Resource Preservation and Development Grants. Water flow data, participation in River Basin Commission Type I and II Studies. <u>Special Activities</u> Special Shad Study Sedimentation Study Flushing Pattern Research	Applies to all six estuaries <u>Special Activities</u> Participation in Conservation, Biological and Heavy Metal Studies	<u>Special Activities</u> Various Fisheries and Fisheries Economic Studies. Milfoil and Sea Nettle Studies BCF Biological Laboratory. FWMCA Chesapeake Technical Support Laboratory. Water Quality Enforcement (Potomac) Administration of Historic Shrine. Participation in various ecological, biological, chemical and geologic studies.
<u>Agriculture</u>	<u>Routine Activities</u> Soil and Water Conservation Projects. Sewer and water Planning and Construction Grants. Watershed Protection. Flood Control. <u>Special Activities</u> Dune Stabilization Adjacent to Delaware Bay	Applies to all six estuaries <u>Special Activities</u> Special Assistance Grants with Measures to Control Pollution	<u>Special Activities</u> Bank Erosion Control Projects
<u>Health Education and Welfare</u>	<u>Routine Activities</u> Marine Health, Pesticides, Public Water Supply Food and Drugs from Marine Sources. Solid Waste. Shellfish Sanitation Program <u>Special Activities</u> Sewage Sludge Dump Site Study	Applies to all six estuaries <u>Special Activities</u> Special Shellfish Sanitation Survey	<u>Special Activities</u> Planned Special Study Regarding Effect of Sewage Plant
<u>Housing and Urban Development</u>	<u>Routine Activities</u> Planning and Assistance in Use of Water Adjacent Property. Area-wide and Local Planning Water and Sewer Facilities Grants. Open Space Land Grants <u>Special Activities</u> None Reported	Applies to all six estuaries <u>Special Activities</u> None Reported	<u>Special Activities</u> None Reported

TABLE V.1.1

Summarization of Federal Activities - Continued

Tampa Bay	San Francisco Bay	Puget Sound	Coordination
			Coordination is carried out in terms of the Requirements imposed on the various programs.
<u>Special Activities</u> None reported.	<u>Special Activities</u> None reported.	<u>Special Activities</u> None reported.	Water Resources Council Associate Membership
			Coordination is carried out in terms of requirements imposed on the program in Enforcement boating safety and the like. Enforcement is carried out in close coordination with State and local authorities.
<u>Special Activities</u> None reported.	<u>Special Activities</u> None reported.	<u>Special Activities</u> None reported.	Water Resources Council Membership.
			Coordination through working closely with State counterparts. Corps projects themselves are developed through extensive coordination of the various needs and expressed desires of State and local interests - and Federal interests.
<u>Special Activities</u> Special hurricane protection measures report.	<u>Special Activities</u> Coordinated comprehensive survey - Navigation Flood control, water supply land reclamation, recreation, national defense, etc., operates Hydraulic scale model.	<u>Special Activities</u> Comprehensive Survey 1969.	Mutual assistance projects, grants, joint projects and studies with States and other Federal agencies.
			Coordination through regulatory activities (the permit system) granting of the permit coordinated with State authorities and with Federal agencies through Interior Corps memorandum of agreement.
			Coordination through the Water Resources Council.
			Coordination through conference, consultation and working in conjunction with State and local personnel. Field level conferences with State and other Federal agency personnel. Formal report coordination through State agencies. Participation in River Basin Commission studies under the Water Resources Council. Coordination thru the administration of grants and subsidies. Permit review in conjunction with Corps of Engineers permit system. Regulatory and Enforcement Activities.
<u>Special Activities</u> Commercial shellfish study, water quality study, Hillsboro Bay Administration of historic shrine. Oyster shell dredging study, BCF Biological laboratory.	<u>Special Activities</u> Establishment of Interior Task Force to work with State. Special Navigation project studies, water quality management study.	<u>Special Activities</u> Various commercial fisheries studies, water quality enforcement (1962), Flushing and Sedimentation Studies. BCF Biological and Technical Laboratory.	
			Coordination through working closely with State counterparts in Soil Conservation Districts. Administration of grants and subsidies. Interagency reviews of projects and work plans. Coordination and cooperation at State level by SCS and State Highway organizations. Participation in River Basin Commission Studies Type I and Type II under Water Resources Council.
<u>Special Activities</u> Sedimentation Study	<u>Special Activities</u> Bay Council of Soil and Water Conservation Districts formed to improve Bay environment.	<u>Special Activities</u> Participation in comprehensive land and water resources study. Management of National Forest Lands, (33% of drainage area) Special Watershed projects.	
			Coordination through working directly and closely with State counterpart organizations. Technical assistance to State and Federal agencies on Marine Health.
<u>Special Activities</u> Heavy Metals Study	<u>Special Activities</u> None Reported	<u>Special Activities</u> Heavy Metals Study, Special Shellfish Studies, Marine Health Science Laboratory	
			Coordination through participation as associate member of Water Resources Council in River Basin Commission Studies. Operation of Planning Assistance Requirements Coordinating Committee (PARCC). BOB Circular A-95 - Coordination of Federal Assisted planning activities. Inter-departmental reviews by executive order and memo of agreement.
<u>Special Activities</u> None Reported	<u>Special Activities</u> None Reported	<u>Special Activities</u> None Reported	

Working from the information presented in the table there follows a discussion as to the adequacy of the programs in meeting the requirements of national interest and Federal responsibility and a review of the current state of coordination.

ADEQUACY OF PROGRAMS

The national interests in the estuarine zone in relation to Federal programs are protection and development of natural resources, commerce and navigation, and national defense.

First, in regard to the protection and development of the natural resources of the estuarine zone, the Department of the Interior very likely has the strongest effect here since it has broad interests and management responsibilities in the use, preservation, development, and study of our living and nonliving marine and related land resources in the estuarine zone. At the same time, the Department is also interested in the equitable and reasonable exploitation of these areas for all manner of business and commercial activities. Through its permit review activities in connection with the Corps of Engineers, definite action goes on with particular emphasis on the protection of the vital fish and wildlife habitats and prevention of water pollution. In general, Interior's programs meet objectives. A serious weakness lies in financial limitations. What is being done is good but not enough can be done. This is particularly apparent in the need for estuarine zone or coastal zone

research laboratories devoted to the problems and the resources of the estuaries and adjacent coastal areas.

The permit control activities of the Corps of Engineers under the Rivers and Harbors Act of 1899, the Fish and Wildlife Coordination Act, as amended, and the Interior-Army Memorandum of Understanding of 1967, act directly in the protection and development of the estuarine resources. Army policy requires permit applicants to seek State approval before its own consideration of the application. The Corps issues public notices and holds public hearings when there is appropriate demand. The permit control activities are effective and cover a large part of the preservation or protection problem, but there are two weaknesses. First, the authority of the Corps to deny a permit on any grounds except impediment to navigation has been successfully challenged in Federal Court. Second, there is the matter of policing or enforcement. The Corps simply does not have sufficient facilities and personnel to police the Nation, thus change and alteration may take place without Corps authorization.

The licensing activities of the Atomic Energy Commission (not in the chart) now cover only radiological safety--this by Statute. They do not take into account environmental effects, thus can supply only limited protection to estuarine natural resources.

The routine activities of the Departments of Agriculture; Health, Education, and Welfare; and Housing and Urban Development, as can be

seen from the chart, contribute to the protection of natural resources for the overall public good. Their effect is not always a direct one but, nevertheless does make a strong and continuous contribution. Like those of Interior the programs are effective. With more funds and facilities they would naturally increase their effects.

For those National Interests of Commerce and Navigation the chart shows a series of activities both contributing and controlling, for this is essentially a direct Federal responsibility.

Commerce supplies the necessary mapping and charting for navigational purposes, the marine weather service and port development. The Coast Guard under Transportation regulates waterborne commerce and maintains navigational aids. The Corps of Engineers maintains the navigable waters and the Department of Health, Education and Welfare maintains a marine health program. Since commercial shipping is one of the most valuable and efficient uses of the estuarine zone these Federal services can be considered adequate to meet the national interests, at least under current law and funding.

Nevertheless, as pointed out in the Report of the Commission on Marine Science, Engineering, and Resources, and in other studies, rapidly changing trends in shipping-containerization and larger ships among other things--make a review of the situation necessary

A thorough study and national survey covering future requirements is needed.

In regard to national security as a national interest in the estuarine zone--the Federal programs appear to be adequate. The Navy as a user relies on the same support programs as does other commerce. Major naval bases, of course, are in the same area and all the logistic support of the many facets of defense beyond the continental limits pass through the area.

THE COORDINATION OF FEDERAL PROGRAMS IN THE ESTUARINE ZONE

With many different Federal agencies managing active and important programs in the estuarine zone, the question is frequently asked, "How is coordination accomplished with this multitude of programs?", or, "Is there any coordination at all?" The assumption is usually made that it's all a very thorough mess and there is no proper control over the situation. In truth, there is coordination and there is progress in obtaining better coordination, yet there are some serious weaknesses, and corrective action is needed.

Specific Means of Coordination

From the chart several distinct and important means of coordination can be seen. These are:

- (1) working closely with State and local counterparts in the development of programs and in mutual assistance--joint projects and studies--data gathering and exchange of information;
- (2) the administration of grants and subsidies--joint review of plans and applications;
- (3) regulatory activities--permits, licensing and enforcement of Federal laws;
- (4) statutes, Executive Orders, Bureau of the Budget Circulars;
- (5) Memoranda of Agreement; and
- (6) the work of the Water Resources Council and its river basin commission and interagency organizations.

The means of coordination are many--the point in question is "How do they work and what are the results?"--at State and Federal levels.

Coordination at the State Level

As the table shows, perhaps the strongest means of coordination is that of working directly with State counterparts in the development and administration of various programs. Through the administration of grants and subsidies the Federal agencies also must work closely with appropriate State and local agencies. The granting of permits and licenses is normally done in conjunction with State agencies. The Corps of Engineers, for example, desires and usually obtains

State approval of permits before granting the Federal permit. The Coast Guard in its law enforcement activities works in close conjunction with State authorities in inland and coastal waters. These are but a few of many examples. There is also coordination at the State level through the river basin commissions and interagency organizations under the aegis of the Water Resources Council since the States are members of these organizations and participate with various Federal agencies in the planning studies.

The fact that there is this coordination at the State and local level supplies an important component of coordination to the Federal programs since the State must attempt to integrate these Federal programs into their own activities. The great weakness is that all too frequently Federal agencies deal only with their particular State counterparts and thus work with the States does not tend to pull the Federal programs together. In those cases where there is a comprehensive State management plan for the estuarine zones and coastal area and there is a State agency implementing this plan, there could be much stronger and more effective coordination.

Coordination at the Federal Level

Coordination of Federal programs in the estuarine zone takes place through several of the previously listed methods in addition to that which results from the extensive coordination at the State level.

Memorandums' of Understanding are one of the most used methods and are particularly applicable to the joint reviews of applications in the administration of grants and subsidies. In regulatory activities there is a continuous series of joint reviews or permits and licenses. The 1967 Memorandum of Agreement between Interior and Army which calls for Interior review of permits from the standpoint of environment and natural resources results in coordination of Interior and Corps of Engineers activities. The enforcement of water quality standards brings about a form of coordination since Federal programs must be reviewed and considered to determine their effect. Passage of such legislation as S.7 or H.R. 4148 would bring an even stronger control and coordination mechanism into play, in that State certification of the fact that an applicant's facility would not cause violation of water quality standards would be required prior to granting a permit or license.

Under statutes, Executive Orders and Bureau of the Budget Circulars, there is a continuous routine of coordination required. For example, Bureau of the Budget Circular A.95 furnishes guidance to Federal agencies for added cooperation with States and local governments in the evaluation, review, and coordination of Federal assistance programs and projects.

Federal programs are also coordinated as necessary by the requirements imposed on them, or in other words, in general order of daily business.

A very good example of this is mapping and charting activities and aids to navigation. When the Corps of Engineers establishes a new navigation channel or changes one, the Coast Guard is informed and makes the necessary changes of navigation aids. The Environmental Sciences Services Administration under the Department of Commerce is aware and takes the necessary steps to have these changes placed on the proper navigational charts. Information regarding the changes is published in the form of Notices to Mariners and put out by the U. S. Naval Oceanographic Office under the Department of the Navy. This is all reasonably automatic coordination, there is much of it and it is very effective.

A most important form of coordination and one which encompasses all our chartered organizations is that carried out under the guidance of the Water Resources Council. As noted in the table describing Federal activities in the six estuaries, membership or associate membership on the Water Resources Council and participation in the planning studies conducted by the river basin commissions or the interagency committees provide a significant means of coordination.

To highlight its interest in the estuaries and estuarine zones the Water Resources Council adopted on November 29, 1967, the following resolution:

It is the policy of the Water Resources Council that the use, preservation or development, and management of coastal, lakes, and river shorelines and islands and estuaries are to be given full consideration in the planning of use of water and related land resources by river basin commissions established under the Water Resources Planning Act.

The Council also considers the planning for the preservation, development and use of estuaries, islands and coastal, river, and lake shorelines and an appropriate use of Federal and State funds in accordance with Title III of the Water Resources Planning Act [which provides authority to assist the States financially in planning for the use of water and related land resources].

The National Council on Marine Resources and Engineering Development charged with the coordination and development of marine sciences created the Committee on the Multiple Use of the Coastal zone (CMUZ) in August 1967. This committee through its meetings, studies, and symposia was an excellent forum for bringing forth the problems of the estuaries and the adjacent coastal area.

In regard to the furtherance of coordination it should be noted that the Water Resources Council, by memorandum for the record dated June 18, 1969, has in agreement with the National Council for Marine Resources and Engineering Development established

procedures whereby the National Council will review plans and studies relating to the coastal zone and that a member of the Council Staff would attend meetings of the Water Resources Council where such plans, studies and reports are to be discussed.

SECTION 4. SUMMARY

It can be seen that the ~~sum~~ total of the current Federal programs in the estuarine zone are broad in scope and reach into every facet of the area. Within the limits of the authorities and resources available these remain well directed towards their objectives and are reasonably effective.

THE CURRENT ROLE

The role of the Federal Government in brief continues to be one of support and technical assistance, of regulatory activities within current law, and of the provision of normal Federal services, such as, navigation aids, channel and harbor maintenance, protective works, and weather service. The Federal Government continues to promote and encourage cooperation among the States in interstate estuaries. It participates in broad studies and inventories particularly as directed by Congress in specific acts. Land acquisition in the estuarine zone continues under the various current laws, and research goes forward.

Augmentation

Even though the Federal programs cooperate reasonably within their statutory authority the accomplishments when combined with State and local activity are not enough as yet to really slow down the loss of valuable estuarine zones. The conflicting demands on the resources of the estuarine zone increase at a

rather rapid rate. Unplanned and unregulated alteration and modification of the area mostly as the result of activities by the private sector continues with a consequent loss of wildlife habitat and a decreasing availability of open space for public use. The cause is in part rapid urban and suburban development, heavy industrial growth and increased population. Development in the estuaries is necessary and will continue, but it should be done in a planned and regulated way designed to provide the most beneficial use. To do so, integrated and coordinated management and planning is needed. This will require more technical assistance of all kinds, more knowledge to be gathered through research and data collection. Not in the least, it will require more effective use of current programs and authorities. This simply means more money and more people. As has been pointed out before in this chapter, the Corps of Engineers does not have the overall facilities and personnel to administer its permit program in the most effective manner. In cooperation with the States, land acquisition by the Federal Government directly and through grants-in-aid programs proceeds at too slow a pace. There is in particular no grant-in-aid program which concentrates its activities in the estuarine zone and which could assist the States in developing that type of State organization that could prepare and implement an integrated and comprehensive plan for its overall estuarine zone.

Coordination

In terms of coordination it is relatively easy to point out that

the strongest coordination of the Federal programs takes place at the State level, that is, that it is accomplished to the greatest extent by working closely with the States. As noted, the weakness of this is generally the lack of a single strong State organization to deal with.

There have been noted many other means of coordination. All appear to work fairly well, but not well enough to provide an effective and comprehensive program of management in the estuarine zone. There is no single policy and no national policy which would provide for the protection of national interests and for development, preservation and use of the estuarine zones for the overall public good. Such a policy would be helpful in the coordination of Federal programs.

A STRONGER FEDERAL ROLE

It is apparent from the above discussion that there are needed additions to the Federal role and programs and that augmentation would be helpful in certain areas.

There needs to be added:

- (1) A national policy with specific objectives to provide coherence to the Federal programs and to lay the basis for better coordination of these programs. This national policy should also contain guidelines to

the States based on the policy and objectives.

(2) A stronger means of coordination of the Federal programs. This could well lie in an interagency group charged with monitoring developments and conditions in the estuarine zones and with providing at specified times a review and report of the situation.

(3) A system of grants to the States to provide them the ability to prepare and implement comprehensive plans for their estuarine zones. These plans and the State organizations behind them could be a strong factor in the effective coordination of Federal programs within the State.

Augmentation is needed:

(1) In various technical assistance, research and information programs and the grant programs supporting these.

(2) In the programs of land acquisition in the estuarine zone.

(3) In strengthening the regulatory and enforcement activities of the Federal agencies. This in terms of personnel and facilities and in terms of strengthened Federal law. The terms of S.7 and H.R. 4148, if passed, will contribute a great deal to this.

(4) In terms of increased broad studies at the Federal level and jointly with the States. Examples not now authorized are a national port study and studies on site

locations for potential electric power generating plans. As noted in the chapter devoted to research needs, continuous broad studies in hydrology, living resources and ecology are needed.

(5) Increased research effectiveness is needed in terms of better use of existing Federal research facilities through organization and reorientation to broader estuarine problems and their solutions. There are also needed additional facilities devoted to research in the estuarine zone, probably in the form of a network of estuarine and coastal zone laboratories, Federal in nature but with State participation.

CONCLUSIONS

In very brief conclusion regarding the Federal programs in the estuarine zone, it would appear that both augmentation and better coordination are needed to assist in providing for a strengthened Federal role. There is also needed a national policy and a set of objectives to provide the basis for a comprehensive national program of management within which a newer and stronger Federal role will be carried out.

Chapter 2

COASTAL STATES' RESPONSIBILITIES, PROGRAMS, AND ROLES

SECTION 1. STATE PROFILE DEVELOPMENT

As specified in Section 5g of the Clean Water Restoration Act of 1966 in amending the Federal Water Pollution Control Act, the National Estuarine Pollution Study and the resulting report to the Congress shall include the development of recommendations for the

" . . . respective responsibilities which should be assumed by Federal, State, and local governments and by public and private interests."

Also, the Act specifies that the Study shall be conducted in cooperation with appropriate State organizations, institutions, and individuals.

Because of the key or important role of the States in managing the estuarine zone, it is essential to define the scope of present management frameworks and from that to develop what should be the proper role of coastal State governments in regard to marine/coastal/estuarine resources. Coastal States are indicated in Figure V.2.1.

Likewise, it is essential to find out weaknesses as well as strengths, accomplishments versus needs, existing organizations versus proposed ones, negative as well as positive views, and deficiencies as well as resources. Thus, the overall State picture must be defined clearly as a basis for creating, building, and basing plans and programs for estuarine management. Towards this goal the National Estuarine Pollution Study obtained from the coastal States the information for the development of profiles which define and outline the State's overall

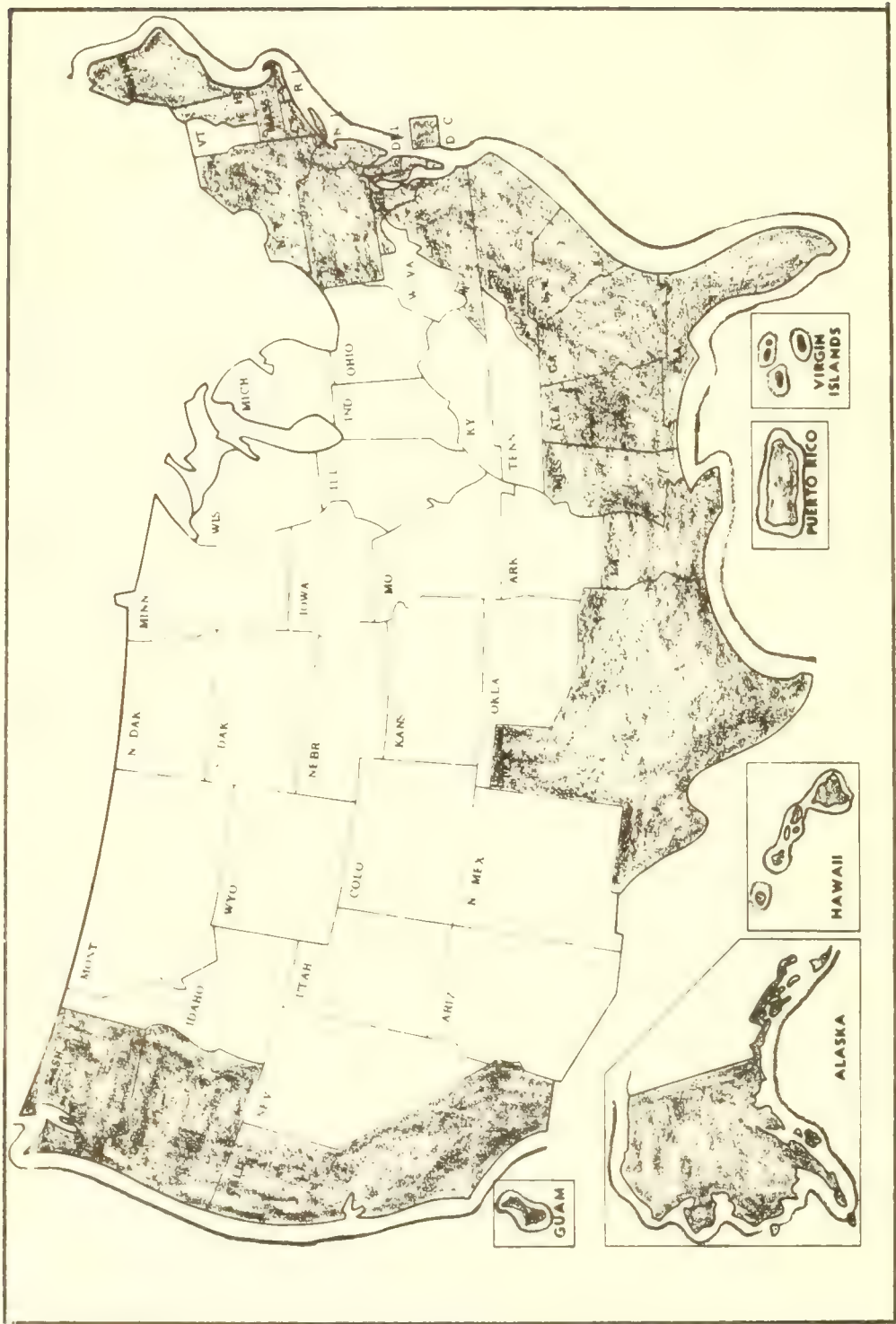


FIGURE V.2.1
The Coastal States (shaded areas)

picture, which define the States' views and which assure that States' opinions are included for consideration in the development of the management plan. The following section of this report summarizes these findings.

METHODS OF PROFILE DEVELOPMENT

The source of material used in the profiles of the coastal States was developed through contacts, direct and indirect, with the State governments and supplemented by material and reports in the technical literature.

Beginning in 1967, the Governors of the 24 coastal States and the territories were notified that the advice and counsel of the States were essential to the success of the Study, and they were asked to designate a person to serve as the State's primary contact point for this project. The primary concern underlying this procedure was that the Study did not want to burden the States with the tasks of completing lengthy questionnaires or providing data summaries and that it wanted to avoid duplication of effort wherever possible.

Subsequently, the Study's regional estuarine coordinators contacted the State estuarine representatives to collect information on the organization and activities of each coastal State in the use of its estuarine resources and to gain the individual State's views in respect to the responsibilities of Federal, State, and local governments in this program. Specifically, each State was asked to provide information

on the following 10 topics.

(1) What State agencies are directly or indirectly involved in the use of the estuarine resources of the States? What are their specific programs and what fiscal and personnel resources are available for carrying out these programs?

(2) What mechanisms, if any, has the State provided for coordination of these programs? For example, highway construction, pollution control and beneficial use.

(3) What are the current problems in estuarine resource utilization within the State, and what are the State views as to how these problems can be managed best?

(4) What information does the State now have on the use of its estuaries? We would like to have copies of relatively recent reports, and would like to have an idea of what additional data may be available in State files but which are not published or organized.

(5) What is the legal authority for the various programs?

(6) What is the legal status of estuary, tidelands, and wetland ownership?

(7) Do the State agencies now have projects under

way which are directly related to estuarine resource utilization?

(8) What is the extent of the present direct control of estuaries by States? What is their size, location, and nature of use?

(9) What are examples of current problems in estuarine management or in conflict of uses? The emphasis should be on pollution or estuarine modification.

(10) What are the present State research facilities used in management of estuaries or study of estuarine resources?

The information obtained from the States on these 10 topics was used to develop the profiles. In many cases to supplement these responses, information available to Federal Water Pollution Control Administration Regional Offices in their files, material presented in transcripts of public meetings, reports published by or about the States, results of other studies such as the Commission's reports, other correspondence with the States' governors or agencies, plus direct consultation with appropriate State personnel were incorporated in the profiles. To assure accuracy and adequacy of the profiles, they were returned to State estuarine representatives for approval at the highest possible level, considering the time available. The following material represents a very brief condensation of this mass of information which is being retained and is available separately from this report. It is

also referenced in Part VII as a part of the supporting information used in the preparation of this report.

Since a most important part of this profile is to be an expression of the States' views on the composition and management of a comprehensive National program for estuarine resources, special attention was directed to this area. The individual State's views with respect to responsibilities of Federal, State, and local governments on this program were very diligently sought, not only through the mechanism mentioned above but also by direct correspondence to the States asking specifically for the official States' views. To assure in every way possible that the States had adequate opportunities to express their views, the preliminary recommendations for the comprehensive management plan, including a summary of the available States' views, were sent to the States for review and then the States were asked to attend Regional/State review conferences held in various sections of the country. The responses varied widely. Because of the emphasis on this topic, in accordance with Section 5g of the Act, these views are presented separately, in section 6 of this chapter.

The following Table V.2.1 presents a brief summary of information received from and about the coastal States in the area of estuarine management information.

TABLE V.2.1
Estuarine Management Information Received from Coastal States

Coastal States & Territories	Profile Material	LETTERS*			Reports	Other**
		State Reps.	Gov. Letters	Other		
Alabama	X				X	
Alaska	X				X	
California	X				X	X
Connecticut	X	X			X	
Delaware	X				X	
Florida	X		X	X	X	X
Georgia	X	X			X	
Hawaii	X					X
Louisiana	X	X			X	
Maine	X				X	
Maryland	X				X	X
Massachusetts	X	X			X	
Mississippi	X				X	
New Hampshire	X	X				
New Jersey	X	X			X	
New York	X	X			X	
North Carolina	X	X			X	
Oregon	X		X			
Pennsylvania	X	X			X	
Rhode Island	X				X	X
South Carolina	X	X			X	
Texas	X		X	X	X	X
Virginia	X				X	
Washington	X		X		X	X
Virgin Islands	X					
District of Columbia	X	X			X	
Puerto Rico	X					

*Views regarding Federal-State-local responsibilities in estuarine management

**Including contracts

SECTION 2. SELECTED STATE ORGANIZATIONS - A SPECTRUM OF DEVELOPMENT

The 24 coastal States have, in essence, 24 different estuarine management frameworks; viewed together they present a broad spectrum of development towards effective and efficient estuarine management.

To show or indicate this broad spectrum of development, the management frameworks of a few selected States are presented. They provide a basis for defining strengths, deficiencies or weaknesses in the States' role and establish a path, leading to a more dynamic and effective role of the States in estuarine management.

The following section of the report previews the management systems of selected coastal States, large to small, rich to less prosperous, populous to sparsely developed, urban to rural, and highly industrialized to mostly pastoral. The selected States are Massachusetts, Maryland, California, Florida, and Alaska. Following this will be a typical State's management framework, State laws, and States' views on estuarine management.

MASSACHUSETTS

Massachusetts is a relatively small, densely populated, highly urban, highly industrialized, and affluent New England area. The population of Massachusetts is about 5,400,000; the tidal shoreline is about 1,500 linear miles including about 45,000 acres of coastal marshland; and about 85 percent of the people live in urban coastal areas. Ownership of the 1,519 miles of shoreline is as follows:

Federal Government	110 miles or about 4,500 acres of coastal wetlands
State Government	45 miles
Local Government	50 "
Universities, etc.	25 "
Private	1289 "

Massachusetts' coastline is widely used by the surrounding New England and east coast community as a prime resort/vacation/historical area. The condition of Massachusetts' shoreline areas affects not only the populace of Massachusetts but also that of the surrounding area since so many people throng to Massachusetts for their livelihood, enjoyment, and relaxation.

Massachusetts has developed legislation and corresponding organizational structure for the management of its estuarine areas. The two principal enactments are: An Act Providing for the Protection of the Coastal Wetlands of the Commonwealth (General Laws, Chapter 768, Act of 1965) and An Act Relative to Removal, Filling, and Dredging in Coastal Waters.

Other enactments include the new oil pollution and offshore mineral resource laws.

The estuarine management activities in Massachusetts are focused on the Department of Natural Resources, headed by a Commissioner. This Department has both operational and regulatory responsibilities in estuarine areas. The Coastal Dredge and Fill Law, the Coastal Wetlands Law and new oil pollution and offshore mineral resource laws are all administered by the Divisions of this department. The organization of this department is described in Figure V.2.2.

The primary means by which the Department manages the estuarine areas, other than Federally controlled areas, such as the Park Service's Cape Cod National Seashore, and the Coast Guard's stations also on Cape Cod, is by restrictive orders - permits, licenses, leases, and so forth - as to the use of these areas, based on the results of public meetings. The Department is placed organizationally high enough in the State governmental structure so that its activities and recommendations are effective in controlling the development of and alteration of estuarine areas. Such an estuarine management organization must be capable of handling and acting on estuarine problems.

In May 1968, by a Commonwealth Executive order (#59) the Massachusetts Commission on Ocean Management was created to develop a comprehensive long-range State plan for the management of Massachusetts estuarine

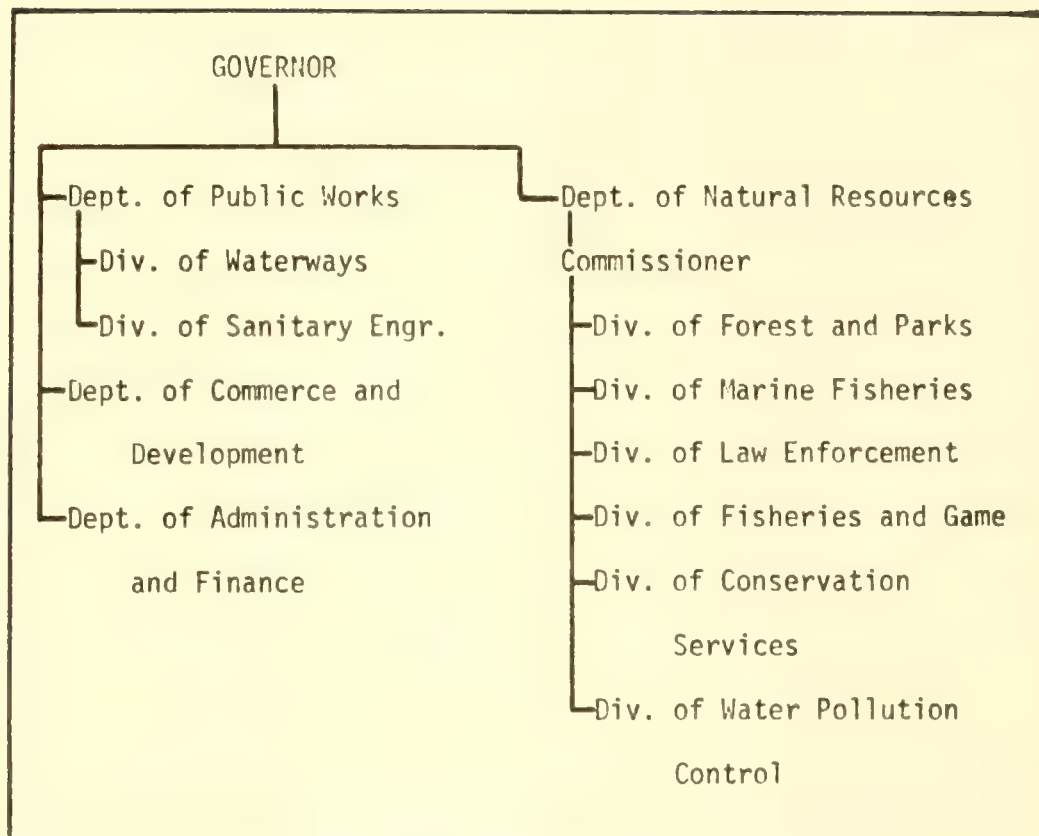


FIGURE V.2.2
Massachusetts' Agencies Involved in Management or Control
of Estuarine Resources

areas and to recommend an appropriate State governmental organization to, in essence, carry out the plan. The Commission's findings will be reported to the Commissioner of Natural Resources.

Other Massachusetts departments which have organizational responsibilities are the Department of Public Works which is also headed by a Commissioner and reports directly to the Governor, and the Department of Commerce and Development which provides planning and program development. A third department, the Department of Administration and Finance acts to provide coordination and to guide joint planning. This department is the agency responsible for personnel, financing, and budget.

Details on the Department of Natural Resources and the Department of Public Works are included in the tabulations on the following pages.

The Massachusetts State government assists the local governments in estuarine management and acquisition through their Self-Help Program which consists primarily of funds awarded to town or city conservation commissions.

The Wetlands Act restricts activities which may pollute the coastal wetlands, whether publicly or privately owned. The Act states that ". . . to immediately provide for the protection of coastal wetlands against the imminent threat of the development of such lands for industrial and other uses detrimental to their preservation in their natural state, therefore, it is hereby declared to an emergency law, necessary for the immediate preservation of the public convenience."

Also, the Act provides that a city or town may take (by eminent domain) coastal lands in the public interest in order to protect them and for the establishment by the U. S. Government of National Wildlife Refuges. Examples are the Parker River National Wildlife Refuge and Monomoy National Wildlife Refuge which place about 3,000 tidemarsh acres under permanent protection. Advantages of this Act are that the State can restrict the use of large areas in general terms or can be very specific as to permissible uses in small areas.

The second Act or "Dredging Act" restricts people from filling or dredging in any coastal waters without prior approval of the respective town or city and the State.

The Wetlands Act of 1965 has resulted in State actions that have restricted the use of approximately 5,000 acres and in proposals to restrict 12,000 more coastal acres including immediate action on approximately 1,700 acres of salt marshes in the North River estuary. (See following coastline map, Figure V.2.3, adapted from an Outline Map of Massachusetts Coast, prepared by the Massachusetts Division of Marine Fisheries, Department of Natural Resources, 1969.)

The estuarine management activities and capabilities of the local-government level in Massachusetts are described in the following Chapter 3 on Local Governments. However, in Massachusetts the towns or local-level governments control both the leasing and regulation of shellfish. The above description of Massachusetts represents a condensation of material in the Massachusetts profile.

DEPARTMENT OF NATURAL RESOURCES

Division of Fisheries and Game. (DFG) Full functional responsibility for anadromous species and for waterfowl and animals. Enforces provisions of State Inland Fish and Game laws and regulations.

Division of Forests and Parks. (DFP) Responsible for providing technical assistance to communities and other agencies in the acquisition and development of marine environment recreation lands.

Division of Law Enforcement. (DLE) Responsible for marine patrol and rescue assistance within the Commonwealth's waters. This agency is responsible for the enforcement of all laws, rules, and regulations relative to marine fish and fisheries.

Division of Conservation Services. (DCS) Serves as a coordinating and interfacing agency between regional within-State groups and also with Federal agencies. Responsible for administering policy on preventing coastal pollution and for preserving biological and zoological systems as related to coastal wetlands.

Division of Marine Fisheries. (DMF) Charged with management of all marine fishery resources within the territorial limits of the Commonwealth except such shellfish and alewife control as has been allocated to the

cities and towns. The program concentrates on estuarine fisheries research and on both basic and applied research on shellfish and lobsters.

Division of Water Pollution Control. A recently created agency to enforce water quality standards.

DEPARTMENT OF PUBLIC WORKS

Division of Waterways. (DW) Executive agency responsible for harbor pollution and for transportation and disposal of refuse at sea. Full functional responsibility for operation and maintenance of the four State beaches and for construction of public recreational boating facilities and for design and construction of shore protection structures and dredging projects in collaboration with local communities. Also licensing and permits for all tidewater structures including fish weirs. Specifically, the division regulates an existing law concerning the removal of sand and gravel from tidal shores. An amendment to the basic law administered by this division gives the local governments some authority since they may call hearings upon any application to remove, dredge, or fill.

Division of Sanitary Engineering. Supervises and controls public water supplies and sewage disposal systems, and regulates public health aspects of shellfisheries.

Six activities, DMF, DW, DFG, DFP, DLE, DCS, have well defined areas of cognizance and cooperate through coordinating committees -- the

Marine Coordinating Committee on Coastal Wetlands and the Recreation Advisory Council within the Department of Natural Resources. The latter council is composed of representatives of all State agencies and other recreation-oriented groups. On an overview basis, the Division of Conservation Services is the authority responsible for the Act which governs keeping coastal areas free from pollution and an Act relative to removal, filling, and dredging in coastal waters. The Division of Waterways, Division of Sanitary Engineering, and the Division of Water Pollution Control act in consort to complete the program. The Division of Marine Fisheries is responsible for identifying what measures must be taken to protect the fisheries but they do not regulate or enforce such measures -- the Division of Conservation Services and its colleagues ostensibly do.

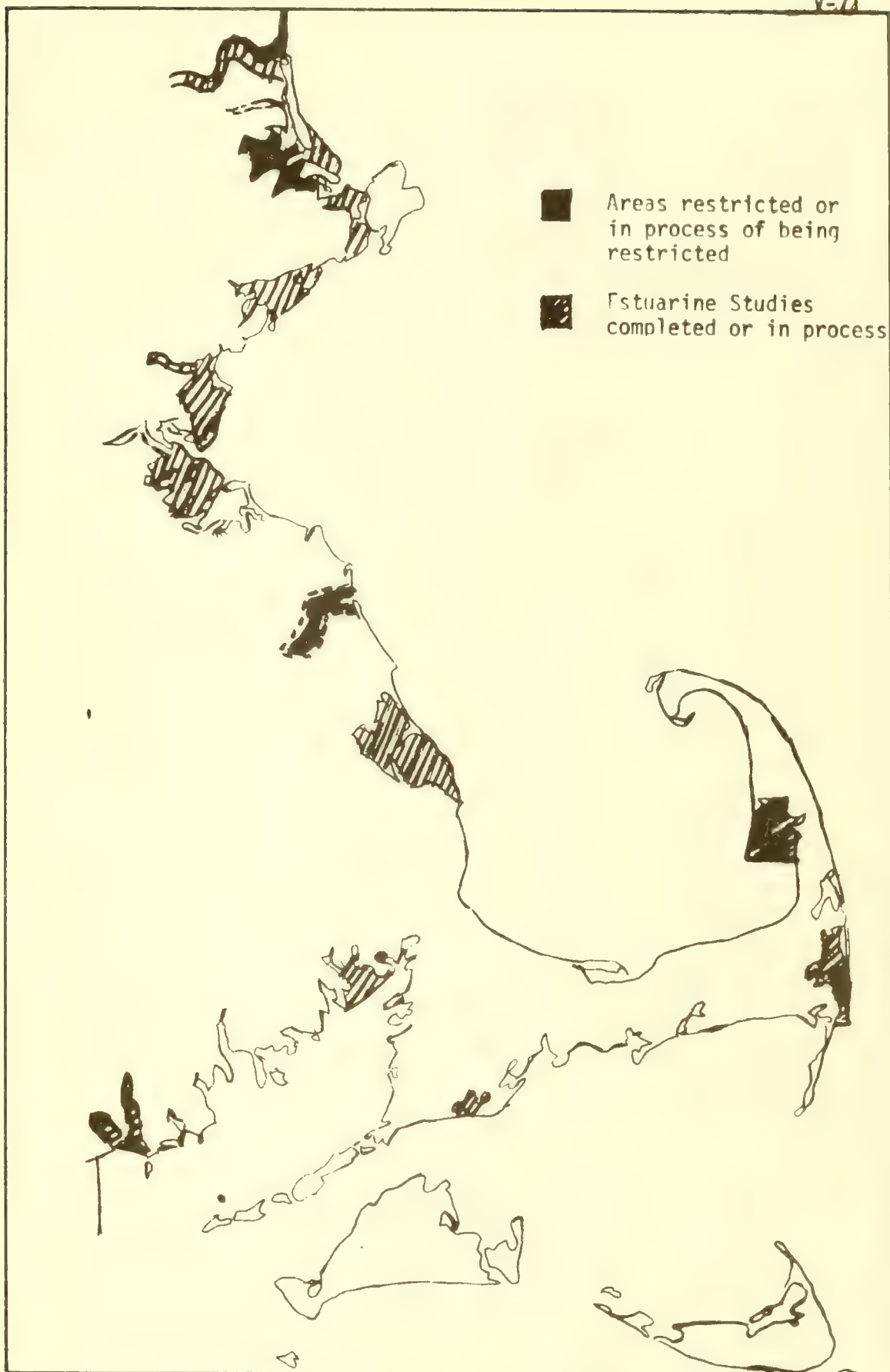


FIGURE V.2.3
Map of Massachusetts Coastline, Showing Restricted-Use Areas

MARYLAND

The State of Maryland is a political entity which encompasses a portion of a major estuarine area--the Chesapeake Bay. Maryland also can be considered as being representative of a State having an urban/rural population mixture with a moderate level of industry and development.

Until July 1969, the Board of Natural Resources acted as the coordinating agency for all public and private activities relating to the natural resources of the State of Maryland. At that time the Board was disbanded, and Maryland House Bill No. 1311 (approved April 1969) created the Department of Natural Resources as a principal department of the State government to be responsible for carrying out policies in the area of natural resources research and development, management, and administration. This department is responsible for the coordination and direction of comprehensive planning in the area of natural resources. The Maryland Department of Natural Resources is composed of the previously existing Department of Chesapeake Bay Affairs, the Department of Game and Inland Fish, Department of Forests and Parks, Maryland Geological Survey, Department of Water Resources plus memberships in numerous commissions, committees, and groups of which the State is a member.

The Maryland Department of Natural Resources has not developed to its full potential in assuming its broad responsibilities of coordinating all duties related to natural resources which exist

in other agencies in the State. Detailed description of the authorized scope of the Department of Natural Resources is included in the Maryland House Bill No. 1311. Therefore, this Department's scope has been briefly described on the basis of the bill and the following discussion is concerned with the prior and continuously existing activities of its estuarine-related departments.

The Department of Chesapeake Bay Affairs has the broad responsibility for planning for the development and management of the Chesapeake Bay and other tidal waters including protection and development of its resources.

The Department of Game and Inland Fish is indirectly involved in estuarine management: issuing hunting, fishing, and other licenses and studying underwater problems affecting wildlife.

The Department of Forests and Parks is indirectly involved in the management or control of estuarine areas in that it promotes good forest management practices on both public and private woodlands, including those adjacent to tidal waters.

Maryland Geological Survey conducts surveys, prepares maps, conducts studies and recommends plans to protect waterfront areas against erosion and deposition.

Department of Water Resources conducts water-resource studies; plans for multipurpose development of waters; cooperates with Game and Fish

and Chesapeake Bay Affairs in determining tidal and nontidal water boundaries; controls use of waters through issuance of permits for such things as waterworks and waterway obstructions; and cooperates with other State agencies in enforcing water pollution control laws and regulations. However, most of the zoning of lands for various uses is done by the local or county-level governments.

Other previously existing and separate agencies that relate to estuarine management are the State Planning Department, which prepares plans for State resource development; Natural Resources Institute of the University of Maryland which conducts research and education programs on nonagricultural and forest resources; Water Resources Research Center of the University of Maryland which sponsors research on water resources development; and State Department of Health which has control over the sanitary condition of State waters. A selective organizational chart of the Maryland government is shown in Figure V.2.4.

The State believes that enforcement of water quality standards and effecting of pollution control is the essential responsibility of the State. To maintain the generally high water quality of the State and to provide for future quality control, the State considers that its responsibility is to expand its ability to perform water quality investigation and control. This is being done with some difficulty in acquiring needed professional personnel and operational funds. However, to meet its responsibilities, the State may need more funds -- perhaps from another source. The State has stated the need for

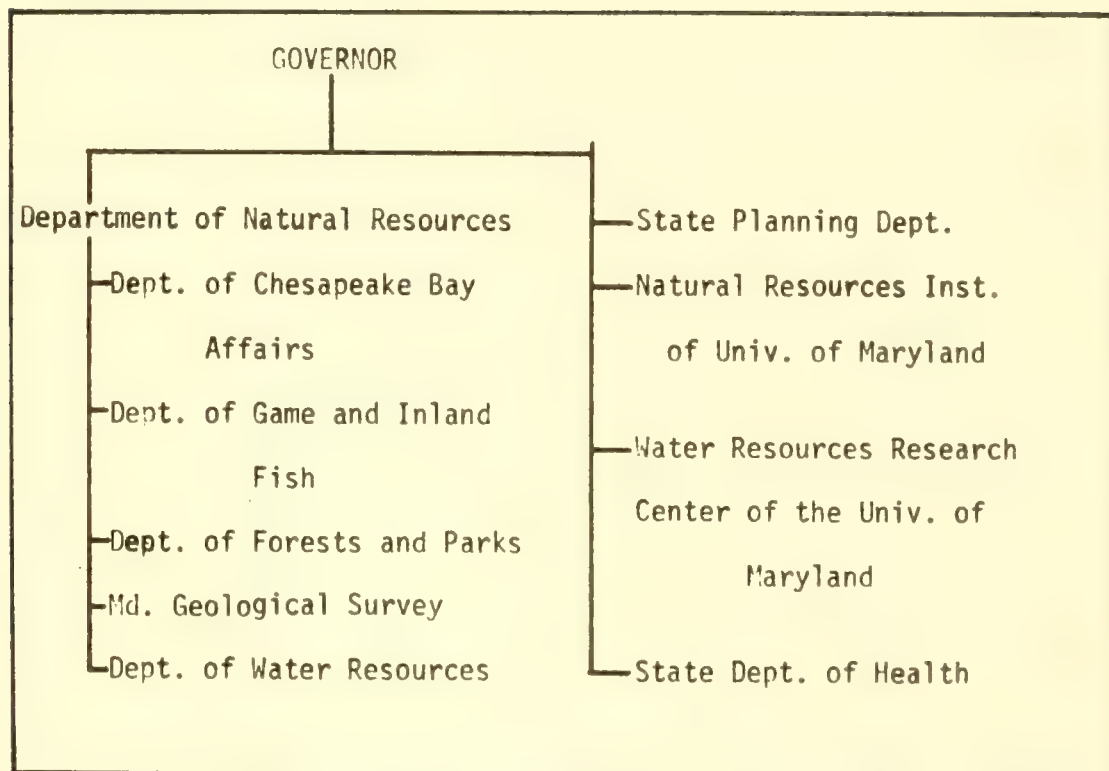


FIGURE V.2.4
Maryland's Agencies Involved in Management or Control of
Estuarine Resources

research on the effects from discharges at specific locations in Maryland on established or proposed water uses. On problems as this, specific research assistance is needed from the Federal agencies. The State has also stated the need or problem that the State's responsibility for controlling dredging and spoil disposal should be strengthened in order to prevent loss or damage to established or proposed water uses. More State-Federal coordination for planning and effecting the placing of dredge spoil is necessary. In the general area of coordination, however, this does not seem to have been a problem and with the newly established coordinating Department of Natural Resources even previous capabilities will be increased and improved.

CALIFORNIA

The State of California represents a western coastal State that is highly urban/highly industrial/low rural/highly developed (population, about 19,000,000). It has an extensive, tidal coastline (about 3,400 miles) that is used for a broad range of purposes and has encountered a wide range of coastal problems including actual coastal filling as in San Francisco Bay.

In general, California has title to all submerged lands, tidelands, and swamplands within its borders and can sell the tidelands and swamplands.

Estuarine management responsibilities in the State seem to be focused in the State of California's Resources Agency. This agency has the primary responsibility for managing the ocean resources of the State; it has advisory, planning, research, development, coordination, and policing functions. The agency and its component departments (as shown in Figure V.2.5) have been assigned specific responsibilities by the legislature for various elements of the resource. A second State department involved in estuarine management is the Department of Public Health. This department is responsible for protection of shellfish beds against contamination and for the health and safety of ocean water -- contact-sport areas.

Special marine oriented groups in the State government include the Interagency Council on Ocean Resources, California Advisory Commission

on Marine and Coastal Resources, Marine Research Committee, Wildlife Conservation Board, and Pacific Marine Fisheries Compact Commission. In addition, there has been intense management activity in the San Francisco Bay area. The State realized the importance and impending dangers in exploration of estuarine resources, especially of San Francisco Bay, and established a program and commission to study and develop action plans for the most effective comprehensive management of the Bay. The State is implementing these recommendations and the Commission itself through the passage of recent legislation -- The McAteer-Petris Act (as amended in 1969). Because the Commission can be considered as an intrastate or local government function it is described and referenced as a case study in the following chapter on the role of local governments and it is included in the Current Overall Program, Chapter 7. Other Bay area groups, in addition to the Commission/program, are the San Francisco Bay-Delta Water Quality Control Program and the Joint Committee on Bay Area Regional Organization.

Specifically the responsibilities of the departments in the Resources Agency are as follows.

Department of Fish and Game has the responsibility for protection, preservation, propagation, and enhancement of wildlife resources. It enforces the regulations regarding open and closed seasons, bag and possession limits, various aspects of both commercial fishing and sports fish and game, and supervises limited-use marine research zones.

Department of Parks and Recreation establishes rules and regulations for administration of beaches, parks, and historical monuments on State-owned lands. The Department acquires, preserves, develops, operates, and maintains for the public benefit, the units of the State park system and is directly interested in how the development and public use of the State parks, beaches, reserves, recreation areas, and historical units along the coast may be affected by unrelated development or use of the tidal and submerged lands.

Department of Water Resources has Statewide jurisdiction and responsibilities relating to development of water resources. In regard to coastal resources the department has responsibility for beach erosion control and saline water conversion; studies erosion problems on the State's beaches; acts as advisors to all government agencies; supervises Federal flood control projects; and makes loans and grants to local agencies for water development projects. It assists city and county governments in beach erosion problems by advancing funds for cooperative programs with the U. S. Army Corps of Engineers.

Department of Conservation is responsible for forest, range, and watershed protection; assists in formation of soil conservation districts and in watershed protection and flood prevention programs; and administers the Forest Practice Act regulating timber harvesting on private land.

Department of Harbors and Watercraft acquires, constructs, develops,

and improves small craft harbors, facilities, and connecting waterways. The Department must, on request, transfer such a harbor and its operation to a qualified local governmental unit. It also has jurisdiction over the establishment of uniform boating regulations and makes loans and grants to assist in development of small craft harbors and marinas.

Water Resources Control Board. In 1967, the Legislature enacted a bill forming the State Water Resources Control Board. This Board, with the Regional Water Quality Control Boards, is the primary State agency in the field of water rights, water pollution, and water quality control. The creation of this State Board provides a coordinated administration of water quality and water quantity.

The Board exercises advisory, planning, research, regulation, and coordination functions. Its principal responsibilities provide for the formulation and adoption of a Statewide policy for water quality control, control of water quality and pollution, and administration of the budgets of the Regional Boards. Each Regional Board is responsible for the formulation and adoption of policies for water quality control within its respective region; it may order offenders to cease and desist and initiate legal action.

The State Lands Division, previously under the direction of the Department of Finance but transferred to the Resources Agency by the California State Legislature in 1969, handles all matters pertaining

to the leasing or sale of State-owned (ungranted) tidelands and submerged lands. It also has an active marine inspection program and provides the focal point for oil pollution control activities in the estuaries and coastal waters of California.

In the realm of coordination, the California Comprehensive Ocean Area Plan, to be developed by the Interagency Council for Ocean Resources, will be the primary vehicle for coordinating the various programs concerned with the conservation and development of marine and coastal resources.

Problems in California center around the need to increase existing management/organization/legislation to keep pace with the extremely rapid development of the coastal areas. The preceding information on the State of California represents a very brief summary of information in the California profile, which also contains detailed descriptions of the various problems regarding estuarine management in the State in regard to both subject area and geographic area.

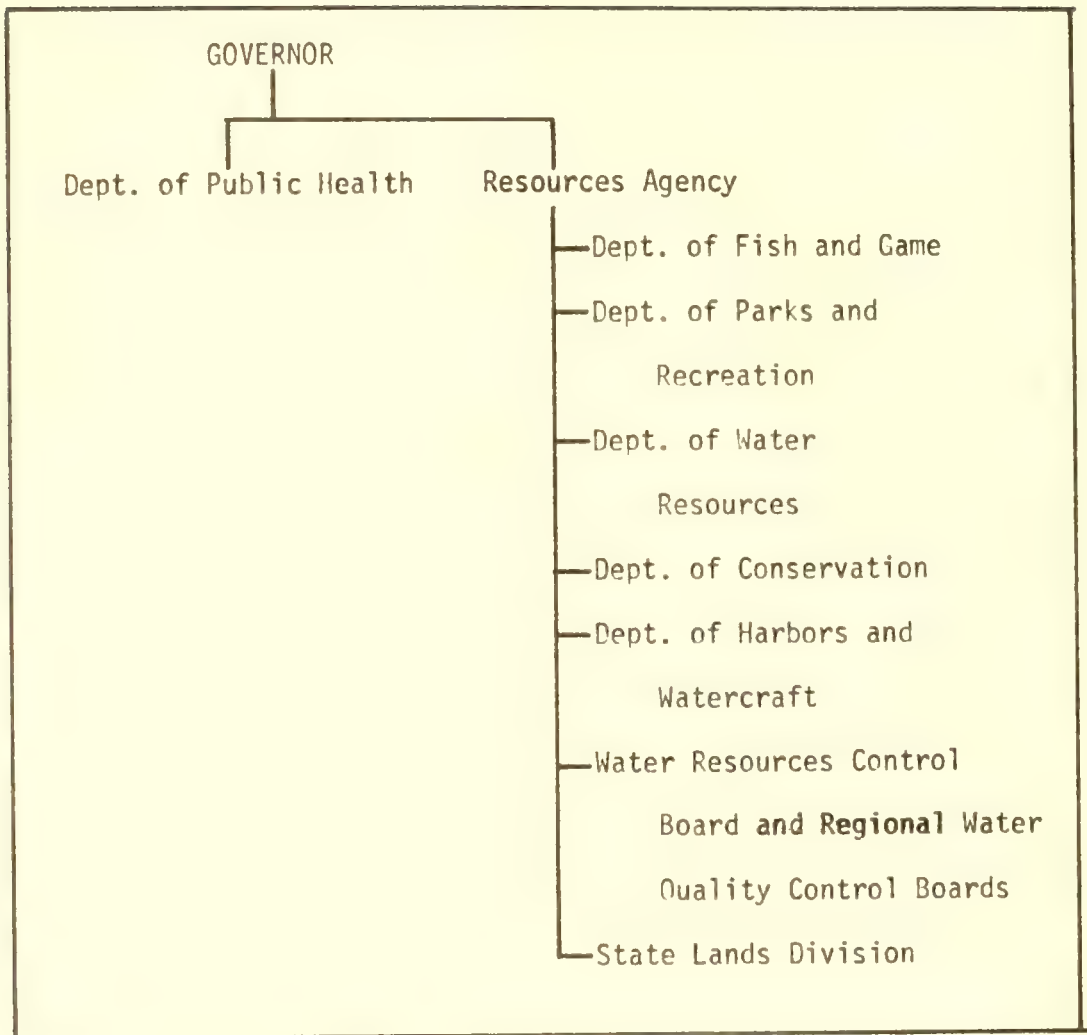


FIGURE V.2.5
California's Agencies Involved in Management or Control of
Estuarine Resources

FLORIDA

The following describes the recently augmented estuarine management framework in Florida which is due in some measure to the efforts of the National Estuarine Pollution Study through its 30 public meetings held across the country. The estuarine public meeting in Florida presented a forum whereby various factors of the community could express publicly their views on the Florida estuarine situation. These views subsequently reached the legislative bodies and it is felt that this meeting contributed views which prompted the Florida Legislature to consider the need for action to preserve/protect Floridian estuaries.

During 1969, the Florida Legislature created the Florida Department of Air and Water Pollution Control and reorganized the State Board of Health as a separate department -- the Department of Health and Rehabilitative Services.

In Florida, there seems to be two coordinated and related foci for estuarine management.

First, the Florida Department of Air and Water Pollution Control is the primary State agency having the responsibility and authority for pollution control. Most of the powers, duties, and functions of other State agencies relating to pollution control, including those in estuarine areas, were transferred to the Department of Air and Water Pollution Control (Air and Water Pollution Control

Commission) by the State legislature through the Florida Air and Water Pollution Control Act of 1967; this represents a consolidation of authority and improved coordination in air and water pollution control activities.

Second, the Board (of Trustees) of the Internal Improvement Fund owns the title to all State-owned submerged lands in estuaries, except those that are privately owned (as described in Chapter 67-393, Acts of 1967). By virtue of ownership, the Board is responsible for the management, preservation, and administration of these submerged lands. The Board can sell, based on approved applications, certain submerged lands after establishment of bulkhead lines by appropriate counties or municipalities. It can also reject applications for title to submerged lands (F.S. Ch. 253.12) or for authority to fill such lands (F.S. Ch. 253.124). The Board approves permits, after initial approval by cities and counties, authorizing dredging and filling. However, some lands have been leased or set aside for specific purposes such as oyster culture, aquatic preserves, and State parks.

Other State departments whose responsibilities relate to estuaries include those duties which logically fall within their aegis, for example:

Dept. of Health and Rehabilitative Services-surveillance
oyster and clam-bearing waters

Dept. of Natural Resources-fisheries and shellfish management
beach erosion control

development of master plan for commercial and
recreational waterways
waterfowl management
State park administration
seafood quality control
seafood marketing program
marine biological research
ecological and environmental studies of projects
pertaining to sale, modification, and development
of submerged lands
Dept. of Agriculture and Consumer Services -- surveillance
of seafood quality and watershed management
land conservation and reclamation
Dept. of Transportation -- bridge and causeway construction
(mainly U. S. Army Corps of Engineers function)

An organization chart showing the Florida State agencies whose responsibilities relate to estuarine management is shown in Figure V.2.6.

Further mechanisms for coordinating agency programs relating to estuarine management include: arrangements whereby plans of highway construction or modification are evaluated by the Department of Natural Resources for the Department of Transportation as to adverse effects on the marine environment. The Department of Natural Resources and the Department of Health and Rehabilitative Services have a formal coordinating agreement regarding each agency's

responsibilities in sanitary shellfish control. The Department of Natural Resources cooperates with the Department of Air and Water Pollution Control on pollution control programs. The Department of Natural Resources' Marine Resources Division reports its findings on the results of ecological and environmental studies of proposed projects pertaining to the sale, modification, and development of submerged lands to the Internal Improvement Fund. Then, in the 1969 session, the State Legislature passed a bill whereby the Department of Natural Resources and the Department of Air and Water Pollution Control are to be represented on the Department of Agriculture and Consumer Services' Pesticide Technical Advisory Committee.

In brief, Florida being a relatively highly urban, low rural, highly developed State seems to have the organizational and legislative basis for the relatively effective management of its estuaries. The current problems in estuarine resource utilization in the State seem not to lie in the area of adequate coordination but in the area of lack of funds and trained field and laboratory personnel to carry out effective pollution surveillance programs and to conduct necessary studies to determine effects of various water uses and assess damages when necessary. A potentially serious problem in estuarine management lies in the private ownership of thousands of acres of submerged land including most of the intertidal marshland in the less urbanized areas of northern Florida.

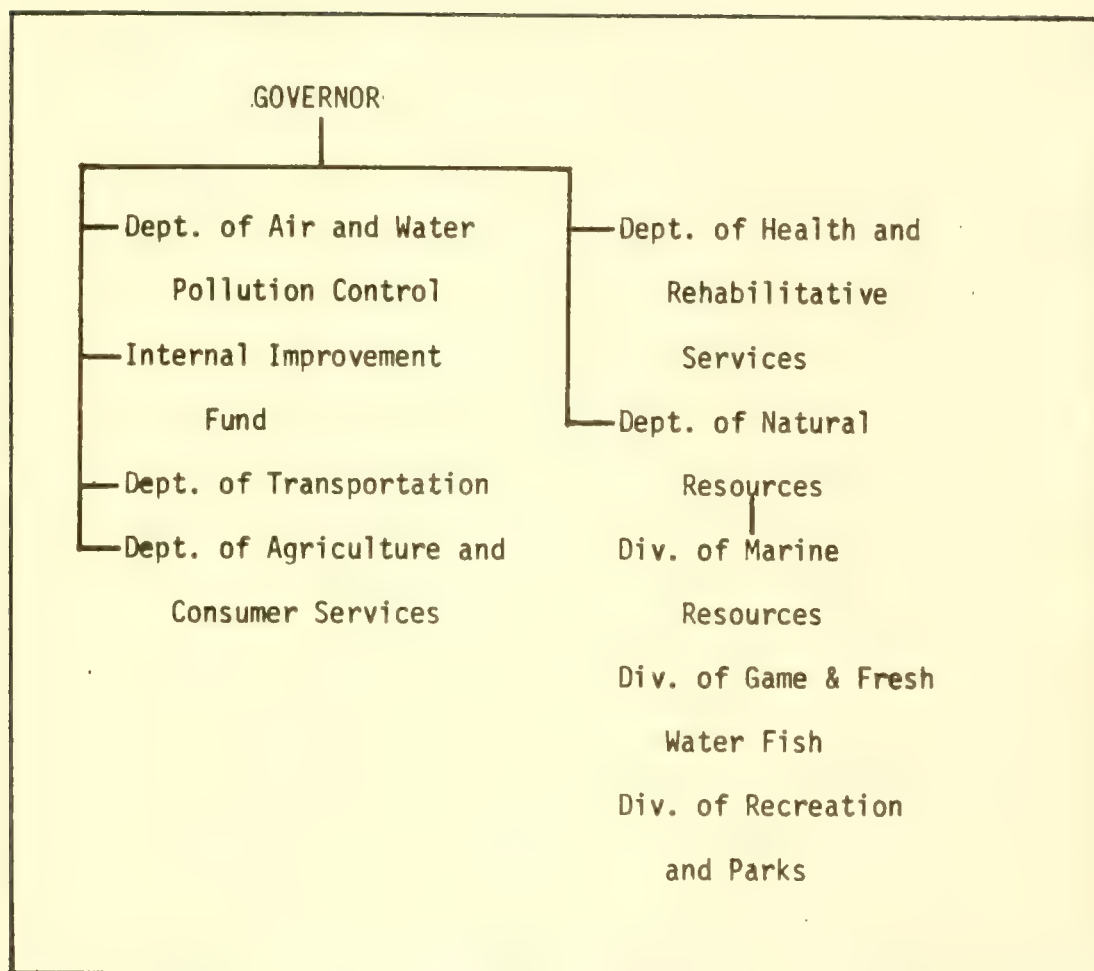


FIGURE V.2.6
Florida's Agencies Involved in Management or Control of
Estuarine Resources

ALASKA

The previously described case studies -- Massachusetts, Florida, etc. -- represent estuarine-management organizational frameworks of relatively well established States. The following case study of Alaska represents a rural and generally light industrial (low development area) State that is relatively new. Alaska has a longer coastline than any other State -- 33,000 linear miles -- a small population, and it is one of three or four political entities in the world that is bounded by two oceans, four seas, and two foreign nations. There is phenomenal public awareness and concern about the State's estuarine areas because more than 90 percent of the population depends on these areas for their livelihood and/or well-being.

In Alaska, because of the vast coastline, the short production or working season and small staff capabilities, the management framework is extremely flexible to allow activities in estuarine areas to be handled on a need basis, rather than based on a preplanned program. Since Statehood, Alaska owns its tidal and submerged lands, with few exceptions. The State cannot sell its tidal or submerged lands but only leases them - maintaining State ownership and control. A large majority of the State's adjacent uplands are under Federal control (parks, preserves, refuges) with cooperative Federal-State management. Because of the general nonexistence of developed local-level governments and competencies, estuarine management is focused at the State level.

In Alaska's State government, three principal departments are responsible for management of the estuarine or coastal zones. These are the Departments of Natural Resources, Health and Welfare, and Fish and Game; ancillary groups are the Department of Public Works and Water Resources Board.

The Department of Natural Resources manages the use of the State's natural resources (water, land, and minerals). Specifically the Department's activities include the management, disposal, and protection of State lands (tidal and submerged within the 3-mile limit); water resources; forestry and mineral resources; issuance of leases and permits on tidal and submerged lands for development such as for log storage and rafting; construction of dock facilities; sale, leasing, and issuance of permits for use of adjacent State-owned uplands and wetlands; and last but not least, the classification of lands as to their highest and most beneficial use. The State has initiated this classification - zoning plan for its tidal and submerged lands as a part of its estuarine management system. At present, about 50 percent of the lands are classified for recreational purposes. In any consideration for leasing and issuance of permits, one of the prime factors is the potential effects of the proposed use on the ecosystem or fish and game in adjacent lands. If land is unclassified, then it must be classed for the highest and most beneficial use before leasing.

The Department of Fish and Game is responsible for managing, protecting, maintaining, improving, and extending the fish and game resources

of Alaska. The Department's Environmental Division coordinates the development of tidal and submerged lands or adjacent waters as they may affect the fish and game resources. This division is the main coordinating mechanism among the Department of Natural Resources, the Department of Fish and Game, and Department of Health and Welfare -- i.e., a coordinator for estuarine related activities. The Departments of Fish and Game and Natural Resources also coordinate their activities related to fish and wildlife through a memorandum of agreement intended to identify and classify fish and wildlife habitats for their maximum protection.

The Department of Health and Welfare includes responsibility for the prevention and abatement of water pollution and for the assurance of adequate supplies of water. This department has responsibility for pollution control.

Ancillary to the above agencies are the Water Resources Board which consists of a group of private individuals who advise the Governor on any and all matters pertaining to the State's water resources (Alaska Statutes Sec. 46.15.210 Art. 3) and the Department of Public Works which constructs and/or maintains small boat facilities, ferry sites, and docking facilities. (See Figure V.2.7.)

In addition to the above coordinating mechanisms, the State coordinates activities through the following two agreements. In southeastern Alaska about 2,000 miles of shoreline are in a National forest. This

area is managed, and respective activities are coordinated through, an interagency agreement among the U.S. Forest Service, the Alaska Department of Natural Resources, and Alaska Department of Fish and Game. Timber sales are held by the U.S. Forest Service and they issue permits for all activities such as for log storage and rafting grounds, only after the plans have been reviewed and approved by Alaska Fish and Game.

Second, is the Waterfowl Protection Agreement. Waterfowl areas on National forests bordered by tidal and submerged lands are managed through a Federal-State agreement among the U.S. Forest Service, Alaska Department of Natural Resources, and Alaska Fish and Game; no activities are conducted on the lands unless agreed upon by all three parties.

Problems regarding estuarine management center on the need for more professional personnel, more funds to enlarge the scope of planning and classification of estuarine uses, and more comprehensive studies of estuarine uses. At present, supposedly the tax base is not sufficient to support an adequate staff; however, recent oil discoveries on the Northern Slope may drastically change this situation. Also needed are more precise definitions of territorial/sea boundaries and more waste disposal facilities.

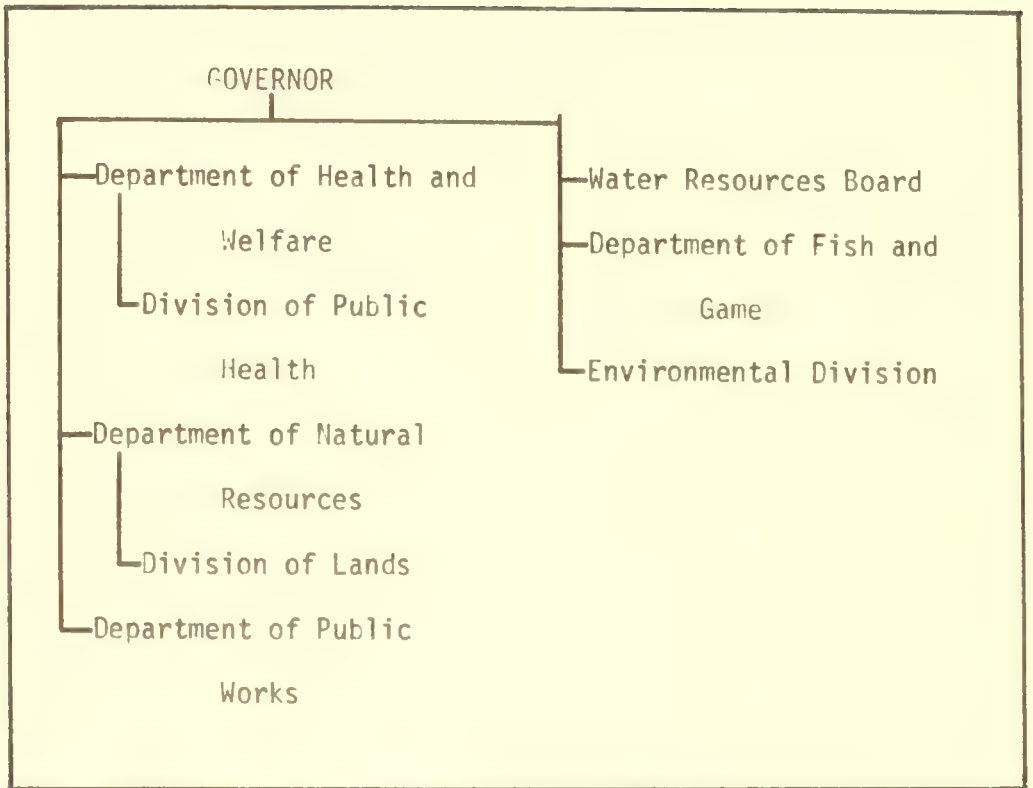


FIGURE V.2.7
Alaska's Agencies Involved In Management or Control of
Estuarine Resources

SECTION 3. A COASTAL STATE'S ORGANIZATION FOR MANAGING ESTUARINE RESOURCES

The preceding section presents a picture of several selected coastal State estuarine management frameworks which show the wide range in management capabilities. Because it is difficult to gain an overview of the 24 coastal State frameworks, the following description is presented as a single State-level estuarine management-organization-legislative framework. It is considered to be analogous to those of coastal States, and it is intended to show what the average State-level organization includes. It is neither extremely strong nor very weak.

The analogous State organization consists of an agency such as the Division or Department of State Lands and Resources which has significant responsibilities for management provided for by statute.

This agency has responsibility for developing natural resources for issuing/approving leases for the removal of material from natural waterways; for granting permits for structures and projects, such as laying cables on coastal lands; and for selling or leasing the lands under navigable waters and along State-owned estuarine areas. However, permits are not required for the disposal of "spoil" into estuarine areas.

Related to this agency are other agencies whose responsibilities involve the use of estuarine resources, generally in a particular area, as follows. The State Fish Commission or Division has the responsibility for the protection, propagation, and preservation of food fish and for the

protection and development of commercial fisheries. The Commission studies, researches, and inventories the marine life and food fish resources; manages fish hatcheries; sets seasons and regulations on taking of food fish and marine life; and by intervention, protects against man-made structures or alterations which adversely affect all marine life.

The State Game Commission sets seasons, regulations, and licensing provisions for recreational harvest of sports fish and wildlife; propagates sports fish and wildlife; and studies, researches and engages in management activities in estuarine waters. By intervention, the Commission advises on all man-caused alterations to the estuaries of the State.

The State Sanitary or Water Pollution Control Authority exercises control of estuarine areas with general powers and duties to set standards of water quality in all waters of the State; enjoins and abates water pollution; and conducts studies to promulgate specific water quality standards for each estuary and portions thereof.

The State Parks Division acquires, develops, expands, and manages all State parks. It protects, preserves, manages, acquires as necessary, and controls the public beaches of the State. The State has ownership and the Department exercises jurisdiction for recreational use of nearly all beaches between extremely low tide and ordinary high tide.

The State Marine Board has responsibility for making rules and regulations necessary for the control and use of boats and watercraft in the estuarine areas and applicable water uses. The Board licenses and identifies boats; cooperates with State and Federal agencies to promote uniform boating laws and their enforcement; assists in local enforcement of boating law; studies, plans, and recommends the development of boating facilities throughout the State; publishes and distributes boating laws; and makes rules and regulations consistent with the State Sanitary Authority and State Board of Health.

The Economic Development Division directs a program of planning and development: serves as a coordinating agency for activities concerning the resources and economy of the State; assists local communities in industrial development; researches all aspects of the State's economy and resources for attracting industry; and publishes general and technical information.

The State Engineer administers laws regarding distribution and appropriation of water. The distribution includes the maintenance of minimum stream flows that have been provided for by policy statements of the Water Resources Board.

The State Water Resources Board supervises and assists diking and drainage districts that may be established in the State and develops coordinated programs for use and control of all the State waters.

The State Forestry Department has direct responsibility for forest protection and conservation on private, county, municipal, and certain Federal forest lands, with the protection of the watersheds influencing both the quantity and quality of water in the estuarine areas.

The State Committee on Natural Resources coordinates resource management of the State and serves as a forum for establishing State policy on the protection, development, and use of the State's resources. Such State committees generally have very small budgets and/or staffs.

The State Soil and Water Conservation Committee supervises the soil and water conservation program. All of the estuarine areas of the State are in local soil and water conservation districts. Programs are underway with these districts in coastal erosion control.

The Port Authorities Association makes technical, administrative, and industrial studies and reports to show the most appropriate and practical ways to formulate a Statewide comprehensive plan for the orderly development of ports and waterways in the State.

All of the above mentioned agencies are provided for by State Statutes or State Laws, or State Constitution. (See Figure V.2.3.)

Coordination and consultation exist between State agencies and Federal or nongovernment entities not covered by permit systems,

laws, or formal arrangements. However, no central coordinating agency exists to handle the management of the State's estuarine resources.

Construction of any facility involving navigable waters requiring a permit from the Corps of Engineers is controlled by consultation between the Corps and the State agencies involved. Water policy of the State is determined by the State Water Resources Board through a public hearing and determination system involving the public and all State agencies concerned.

Principal problems existing in the analogous State are in the area of the need for more coordination of existing activities; resolution of conflicts regarding ownership of estuarine and upland areas; clear statement of ownership which is basic to determination of rights, developments, and erasing of conflicts by wise long-range planning; comprehensive planning to preserve and provide for the orderly development of estuaries, with the States taking the initiative; funds (Federal) to assist the States in long-range planning and coordination; increased involvement of government, industry and all citizens in estuarine planning, development, and protection; enforcement or strengthening of existing State laws; establishment of guidelines by the Federal Government for use by the State to assist in establishing uniform regulations especially for watercraft; and last but not least, the major need

is for an orderly improvement program of water quality within the estuaries, providing broad guidelines allowing for multiuse.

In brief, the analogous or average State management framework includes capabilities for planning, regulating, and controlling, at least to some extent, certain uses of estuarine resources, through the use of restrictive provisions. For example, it can issue leases for the removal of material from waterways; issue permits for structures; lease lands under navigable waters; issue licenses for sport fishing and wildlife; control public beaches; set water quality standards; issue licenses for boats; and manage State park lands.

However, what is often lacking is a strong management organization able to coordinate all estuarine-related activities and able to produce and implement a Statewide comprehensive management plan which includes enforceable provisions and regulatory authorities to control use or modification of the estuarine resources for the maximum benefit of the population.

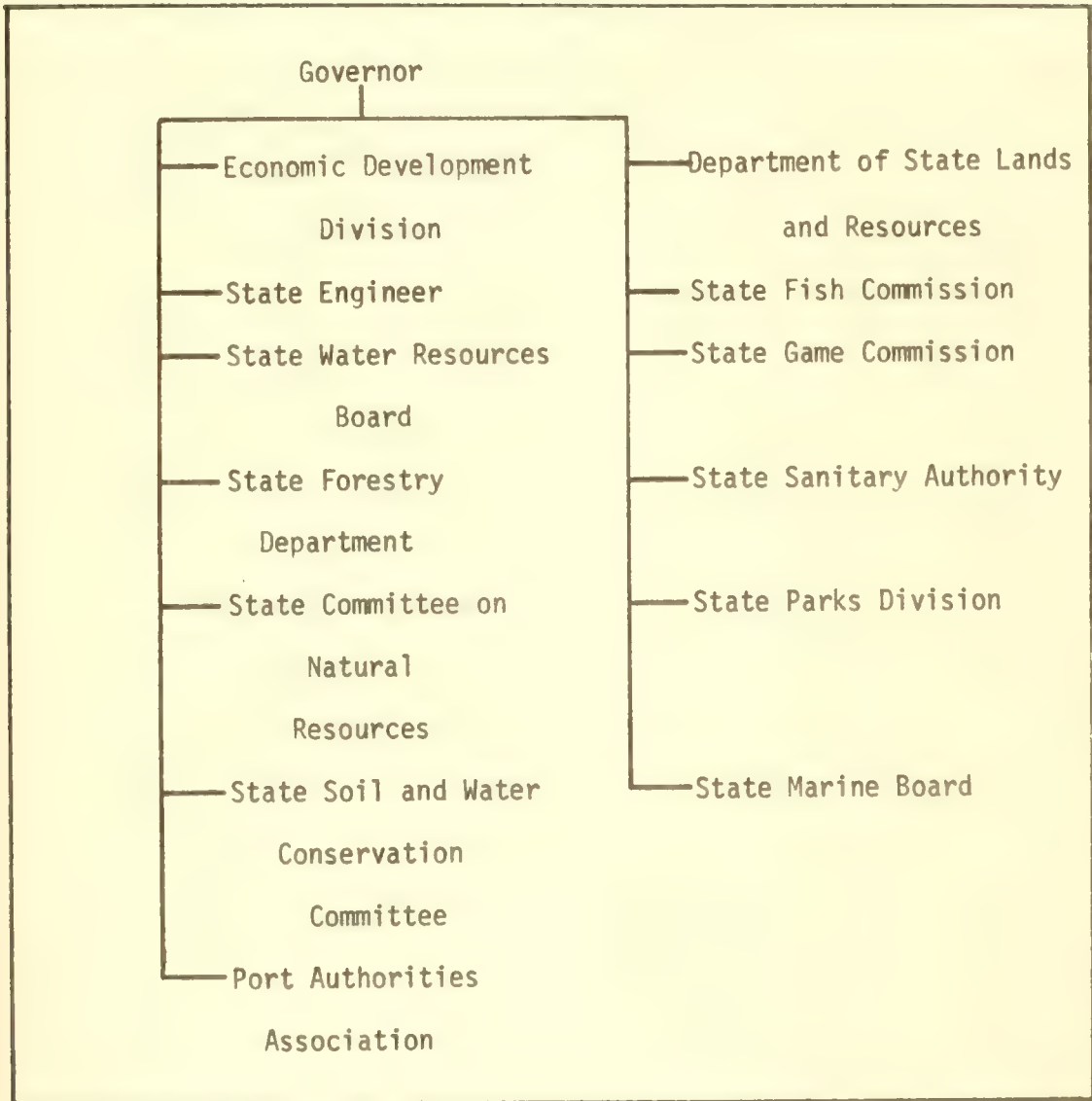


FIGURE V.2.8
Analogous State Agencies Involved in Management or
Control of Estuarine Resources

SECTION 4. STATE ESTUARINE LAWS AND OWNERSHIP PROBLEMS

No uniform State-level estuarine law framework exists; there are, instead, many laws, often conflicting, which affect the estuarine zone. The States' estuarine legal system is a confusing and complex blend of water rights, land ownership claims, use conflicts, and State, Federal, and local laws which vary from area to area and are often subject to varying interpretation and constant litigation. This section briefly discusses the legal aspects of estuarine management, in particular ownership problems and State laws; it does not include a comprehensive survey.

Some fundamental legal questions on estuarine use are (V-2-1):

- (1) How much of the estuarine zone is owned by Federal, State, and local governments and by private parties?
- (2) How was ownership acquired (e.g., colonial or legislative grants, adverse possession, condemnation, leases)?
- (3) What limitations are there on ownership -- what rights and privileges does the public have to use estuaries and their resources including privately owned lands?
- (4) What kinds of legislation and regulatory tools are constitutional and offer the best framework for management of the estuarine zone?

BASIC STATE-LEVEL LEGAL PRINCIPLES

The above questions indicate the variety of legal and policy problems. However, some basic legal principles and trends can be outlined, even though their application has varied historically from State to State. A fundamental doctrine dating from its English common law origin is that of the public trust and right -- that these coastal and submerged lands are held by the State in trust to be used by all the people for certain purposes, such as navigation, commerce, hunting and fishing, and (more recently) for parks and recreation. Public ownership usually includes four types of lands:

- (1) submerged lands (beds of navigable waters owned by the State up to the 3-mile territorial limit) and
- (2) tidelands (generally defined as the coastal area between mean high and low tides).

The extent of the public's right to use and have access is less clear in the case of

- (3) marshlands or swamplands (subject to extremely high tides) and
- (4) abutting lands which are affected by water uses.

Subject to the paramount Federal interest in protecting navigation, the States generally control the uses of water within their territorial limits. Under their police power they may regulate pollution, sewage disposal, control harbor lines, grant fishing and hunting licenses, and issue boating permits. The land-use prerogatives of

the State, such as zoning, have usually been delegated to the municipalities and local governments.

Although held by the State in trust for the public, some tidelands have been purchased by private owners. However even when sold, the public has the right of commerce, navigation, and fishing in these areas. These use rights remain until the area is dredged or so changed physically that these rights can no longer be exercised.

OWNERSHIP PROBLEMS

In practice, problems of estuarine zone ownership and use rights abound in every coastal State. Despite the commonly accepted public trust doctrine, States can and have transferred ownership to private individuals by outright grants. Short of purchasing the land, individuals have acquired rights and more limited interests through leases, easements, other licenses, and permits. Questionable surveys and dubious colonial and pre-colonial land grants further complicate the situation. The private interests who acquired ownership or use rights often proceeded to "improve" and "develop" the land through dredging and filling.

Thus, judicial clarification by each State is needed for such ownership questions as -- are these titles still valid? Is the sold land still subject to the public trust? Can the State revoke licenses it granted and on what grounds?

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SUBMERGED LANDS: STATES VS. FEDERAL GOVERNMENT

Several court decisions and Congressional acts have failed to settle definitely the question of Federal vs. State jurisdictions over submerged lands, minerals, and ocean islands. In 1947, in *U. S. vs. California* (332 U.S. 1947), the Supreme Court ruled that the Federal Government and not the State had paramount rights in the submerged lands and oil found under it in offshore navigable waters. This displacement of State regulatory authority in the 3-mile belt off the coastline was subsequently applied to Louisiana and Texas by the Court. The Supreme Court's decision in issuing this opinion states that:

"California is not the owner of the 3-mile marginal belt along its coast, and . . . the Federal Government rather than the State has paramount rights in and power over that belt, an incident which has full dominion over the resources of the soil under that water area, including oil."

To offset these so-called tideland-oil rulings, Congress passed the Submerged Lands Act of 1953 which generally gave the States title to the lands, minerals, and other resources underlying the navigable waters within 3 miles off the coast; beyond that it was under Federal jurisdiction. Nevertheless, this law failed to clarify several questions of ownership, taxation, and regulation. For example, how the seaward boundary or island waters are defined is unclear.

Litigation has attempted to settle the question of measurement from artificial jetties and in relation to river deltas and islands. There is, however, still some jurisdictional uncertainty over the submerged lands surrounding some islands and over man-made lands and emerging islands.

A supplemental Decree of the U. S. Supreme Court in 1966 established California's offshore ownership boundary line. The ownership boundary extends 3 geographical miles seaward from the coastline. Much difficulty is associated with the establishment of the exact location of this line. In addition to the problem of establishing the line, the base line for measuring the State's boundary is the "outermost permanent harbor works." Disputes have arisen over the interpretation of this phrase. Another problem has to do with the State's seaward boundary in the Channel Islands area off the southern California coast. These jurisdictional problems are extremely important for planning and management of the coastal area and financially, because of royalties from oil leases and other developments of the submerged lands.

These difficulties point up the need for an organization to handle such boundary disputes on a national level or a higher-than-State level. This need has also been expressed by the Panel (on Management and Development of the Coastal Zone of the Commission on Marine Science, Engineering and Resources) in their recommendation that a National seashore boundary commission be established by the Congress

with authority to hear and determine coastal boundary questions and controversies involving proprietary interests of the States.

In addition, the Supreme Court was asked in June 1969 to rule on a dispute between the Federal Government and the thirteen Atlantic States over title to offshore lands (Docket No. 35 original, 37 Law Week 3483). These States claim that for the purposes of granting leases and collecting royalties for oil exploration and production, and on the basis of colonial charters granted by the British Government before the Constitution was adopted, their authority extends up to 100 miles on to the Outer Continental Shelf. Texas and Louisiana have also asserted jurisdiction beyond the 3-mile zone in another unresolved dispute.

DIVERSITY OF STATUTES AMONG STATES

A survey of intergovernmental relations in the coastal zone disclosed that: (V-3-2)

"State statutes establishing distinctions between public resources and private property and the extent of State responsibility for management of public resources have little in the way of uniformity. Even if legislatively clear, the distinctions are difficult to fix on the ground. The resulting situation is a legal nightmare."

In effect there is a separate legal system for each coastal State and

management programs for the States must take each of them into consideration. A broad range of estuarine zone policies are affected by some of these interstate variations:

(1) Basic Water Laws -- Eastern States follow the riparian doctrine, in which water rights are tied to ownership of adjoining or underlying land. Western States generally accept the first-in-time, first-in-right appropriation doctrine in which rights are acquired or abandoned by use. Unlike riparian law, priority in time determines water rights, independent of land ownership. To complicate matters further, States on the Pacific recognize both these rights while Louisiana accepts elements of the Napoleonic Code.

Water law does not closely control water use. For example, under riparian law, water should be free from "unreasonable" pollution so that "reasonable" use may be made of it.

Yet the interpretation and application of these water rights affect the type of improvements and accretions that may be made by riparian owners, such as reclaiming land, constructing piers, or removing sand and gravel.

(2) Tideland Boundaries -- a majority of States claim ownership under English common law from the high water mark seaward to the 3-mile limit, but, there are significant variations. Massachusetts, New Hampshire, Delaware, Pennsylvania, Virginia, and Georgia permit private land

to the low water mark. Thus, in Chesapeake Bay, Maryland claims all the coastal land from the mean high tide mark while Virginia asserts its ownership only from the mean low tide.

Standards of measurement also frequently differ. Louisiana measures from the highest winter tide and Texas from the mean higher tide. Further complications arise from the fact that, even if precise and standardized measurements are used, tidal characteristics vary from coast to coast.

(3) Outer Limits Claims -- While State territorial boundaries are generally considered to extend only out to 3 miles, some States exert claims to waters beyond this limit. Louisiana, for example, claims up to 27 miles and Texas up to the outer edges of the Continental Shelf.

(4) Extent of Delegated Powers -- Most States delegate the responsibility for the use of land above the high water mark to their municipalities and counties. However, a few like Hawaii stress Statewide zoning and reserve this prerogative to the State. In general, there is a wide variation in the extent of home rule granted by each State to its localities.

In conclusion, the boundaries of private property in tidelands

vary from State to State. Almost each State differs from its neighbor in how it defines and interprets such basic units and concepts as submerged lands, navigability, tidelands, marshlands, and abutting lands.

REGULATORY POWERS OF THE STATES

Under their police powers, the States can legislate for the protection or promotion of public health, safety, moral, or for the general good. This attribute of sovereignty enables the States to regulate the use of estuarine zone, land, and waters and to control the actions of individuals upon them. Despite the many variations among States, the basic Constitutional doctrines which allow them to create and enforce property rights for use and transfer can be outlined along with some important limitations on this power.

Among the legislative tools which can be utilized in estuarine management are the following:

- (1) a declaration of public rights, such as access;
- (2) zoning or allocation and use controls, usually delegated to the local subdivision;
- (3) taxation, used preferentially for estuarine preservation;
- (4) development easements, or the purchasing of partial public rights; and
- (5) eminent domain.

Yet there are limits to these broad State powers. First, the supremacy clause of the Constitution may prevent the State from acting in an area where the Federal Government through its interstate commerce and treaty-making powers has preempted the field. Secondly, the establishment of estuarine rule-making bodies may occasionally be subject to attack as an improper or invalid delegation of legislative authority.

Third, procedural due-process may invalidate State actions that are taken without notice and/or the opportunity to have hearings before the affected parties.

Also, the equal protection doctrine requires the government to act fairly in treating all alike without arbitrary or discriminatory classifications.

Finally, and most controversial, substantive due-process, not allowing any property to be taken without just compensation, can be interpreted to disallow use restrictions that may deprive or damage property owners. Courts vary in their interpretation of the States police power and the extent to which they will permit use restrictions without declaring them to amount to a taking of property without due compensation. It is particularly unclear if a State can repeal, modify, or deprive private owners of their future improvement rights. Especially in the case of fill control, there are few yardsticks as to what compensation or fair return must be allowed

an owner. The variation in dredge-and-fill regulations among the coastal States is indicated in the following Table V.2.2. It also points out the States which apparently do not have a State-level regulatory permit system for dredge-and-fill operations.

Most State laws are considered to be legitimate exercises of the police power under a presumption of validity, although there have been some significant exceptions to this rule. Thus, to avoid involved litigation and possible annulment, State laws must be carefully drafted to avoid being successfully contested on the above grounds.

MODEL STATUTE GUIDELINES

Many of the coastal States expressed a need for guidelines for assistance, especially from the Federal Government, for the development of adequate or strengthened regulations for the use control of resources in estuarine areas, or portions thereof.

In response to this call for assistance, the National Estuarine Pollution Study, through a contract awarded to the University of Maryland School of Law, developed a Model Statute for Chesapeake Bay Basin Management. The Chesapeake Bay was selected for this project because it possesses many characteristics, benefits, potentials, and problems which are common to many other estuarine areas of the United States. The model statute, developed under this contract, is included in the following Chapter 9 of this Part V of the report.

TABLE V.2.2

State-Level Regulatory Systems for Dredge-and-Fill in Coastal Areas

State	Yes	No	Partial
Alabama	X		
Alaska		X	
California		X	
Connecticut	X		
Delaware		X	
Florida	X		
Georgia		X	
Hawaii		X	
Louisiana		X	
Maine	X		
Maryland	X		
Massachusetts	X		
Mississippi		X	
New Hampshire	X		
New Jersey	X		
New York	X		
North Carolina	X		
Oregon			X
Pennsylvania		X	
Rhode Island		X	
South Carolina	X		
Texas		X	
Virginia		X	
Washington		X	
Virgin Islands		X	
District of Columbia		X	
Puerto Rico			X

The statute is considered to be applicable in principle to other estuarine areas of the United States, and it is presented as suggested guidelines which could be tailored by the coastal States to meet their needs in important estuarine areas in order to improve or strengthen their management capabilities. Of course, it is recognized that some States have made significant progress in this direction. Such guidelines were developed on the basis of a selected geographic area (Chesapeake Bay) merely to insure an element of reality and practicality rather than a purely theoretical approach. Therefore, these guidelines do not imply the need for action by the governing States, but merely a response to an expressed need.

SUMMARY OF STATE ESTUARINE-RELATED LAWS

State governments are both owners and regulators of the estuarine zone. They generally have sufficient legal and constitutional authorities to act. Yet in practice, most State Laws are ineffective; they are sorely out-of-date and need updating, revision, and a basic reorientation towards comprehensive management and regulation of estuarine resources.

At their worst, State laws affecting estuaries are rudimentary, antiquated, and fragmented. There may be laws dealing with water quality or land zoning but they are uncoordinated and sometimes inconsistent with each other.

On the other hand, some States have adequate laws which touch upon estuaries but they fail to focus on the estuarine zone as a unit and deal with fragments and pieces of the total picture. Thus, a State may have a law to control dredging or filling or regulate leasing and sale of public lands or the construction of harbor and marina facilities and yet fail to develop a comprehensive estuarine management policy for optimum use. Further, they may fail to use effectively or enforce the laws that they have.

With the increasing concern over the future of the estuarine zone, there has been a gradual change from general permissiveness towards greater government planning and control. A few States have begun to use the full array of tools already available in a total, coordinated manner for estuarine conservation and development -- use control through planning, a less than full fee interest, permits and licenses, and favorable tax treatment. Here, too, the Federal Government can encourage State planning and coordination of the operations of several interrelated agencies dealing with water quality standards, economic development, recreation, and conservation. One of the best means toward this end are the grants for State planning under Section 701 of the 1954 Housing Act (40 U.S.C. 461).

The Commonwealth of Massachusetts is probably farther along the way toward optimum estuarine management. First it enacted a stop-gap law, the 1963 Coastal Dredge and Fill Act (Mass. Gen. Laws Ch. 130, Section 27A, 1963) which gave the Director of Marine

Fisheries 14 days notice to impose protective conditions on the permit he issues. However, to allow for the long-range planning and optimal resource evaluation and allocation, the Massachusetts Coastal Wetlands Protection Act was enacted November 23, 1965 (Mass. Gen. Laws Ch. 130, Section 105, 1965). This law authorized the Commissioner of the Department of Natural Resources to promulgate orders regulating, restricting, or prohibiting alteration or pollution of Massachusetts' coastal wetlands. Alarmed by a report (V-2-3) which stated that 43 percent of the remaining wetland acreage was subject to alteration and destruction in the near future, the Legislature permitted these lands to remain privately owned, but allowed the Commissioner to restrict their use. Such use restriction orders may be adopted only after holding a public hearing in the municipality in which the affected wetlands were located. It is still too early to assess fully the implementation of this Act but its effectiveness as a legal tool for estuarine management has been widely praised (V-2-4).

Another approach towards land use has been taken by the State of Hawaii. Recognizing that land use is a policy power of the State, it has not delegated this authority to its local subdivisions. Rather it has adopted a zoning system to promote State wide and regional goals to protect its invaluable aesthetic and natural resources.

Finally, the State of Wisconsin has adopted a Shoreline Zoning Act which, although Wisconsin is not a coastal State, could be applied to the estuarine zone of coastal States. Under this Act, the State sets standards for "country" zoning of unincorporated areas as well as broad objectives such as the prevention and control of water pollution plus the protection of fish and aquatic life and natural beauty. Further, the State is directed to adopt its own ordinance for counties that fail to enact or meet minimum objectives or standards. The State has also issued a model ordinance and planning guide which designates three zoning areas -- conservancy districts, recreational areas, and general purpose zones (V-2-5).

Adoption and adaptation of the Wisconsin, Massachusetts, Hawaii, or model approaches to State zoning and/or use control would eliminate piecemeal estuarine zone planning and lead to optimum management and development in the public interest.

SECTION 5. EVALUATION OF COASTAL STATE FRAMEWORKS

An evaluation of the overall coastal State picture of estuarine management reveals a pattern or trend that is quite bleak. However, some coastal States have made significant progress towards effective estuarine management.

In the realm of organization, each coastal State has some type of mechanism, capabilities, or organizational framework directed towards estuarine management. But most of these frameworks are, unfortunately, inadequate, not effectively coordinated, not strong enough, or not adequately staffed nor financed. Those States, which seem to be making a definite attempt to handle their estuarine management capabilities, have a central organizational/coordination focal point. A primary factor in the organizational format is that the effective ones are placed high enough in the State structure so that they can operate efficiently and not be overburdened by needless bureaucratic delays. But this focal point cannot exist alone. It is only a first step towards estuarine management. Second, the policy dictated and effected by this central agency must be in accordance with, and supported by, a Statewide comprehensive estuarine management plan. The plan must be approved by the State and it must consider all aspects of the use, development, and protection of the estuarine resources for the maximum possible benefit of the populace, not only in the State but also in the region

affected by the resource. Third, the comprehensive plan must include sufficiently strong regulatory authorities -- licensing, permits, leasing, and restrictive use provisions -- so that the implementation of the plan by the central agency will be truly effective. The effective tying together of these three points (organization-plan-authority) depends on coordination.

THE ORGANIZATION

Details on the structure of the States' central organizational focal points can be gained from the preceding case studies. The specific structure would, of course, vary with the size, scope, development, population, political atmosphere, and financial capabilities of the particular State. No one organizational format can be presented as being representative of all the coastal States; nor should one type of format be imposed on all of them.

Fanning out from an organizational entity are the various other State agencies which have responsibilities dealing with particular aspects of estuarine management; for example, the fish and wildlife agency issues hunting and fishing permits, the park service manages the State parks, and the port authorities handle the harbors. These individual agency responsibilities are generally not, and need not be, merged or included in the specific estuarine organization. This would often create additional difficulties

and needless duplication, because estuarine activities cut across all facets of a coastal State government. However to be effective these individual responsibilities and activities must be effectively and efficiently coordinated through a conscientious spirit of cooperation. More often than not, these activities are not sufficiently coordinated. .

THE PLAN

The State organizational entity, when effective, is backed up by and empowered to develop, approve, and/or implement a comprehensive Statewide estuarine management plan or concept. In respect to these management plans, the States generally do not have approved comprehensive Statewide management plans to guide or provide a basis for the activities of the organizational framework. When existent they are often very flexible, nebulous, incomplete, confusing, and rely more on the individual experts to solve problems, as they arise, than on preplanning.

THE REGULATIONS

The comprehensive management plan and the corresponding organizational entity, when existent, are empowered or strengthened, directly or indirectly through coordination mechanisms, by regulations, provisions, statutes, and procedures for use control either through zoning, acquisition, restrictive covenants, or State ownership of submerged lands. This lack of organizational frameworks,

coordination, planning, and regulatory authorities is evidenced by the plight of our coastal areas and by the numerous responses from coastal States for the varied types of Federal assistance and coordination as described in the following section. Details on the range of State laws, which also vary based on the characteristics of the State can be gained from the preceding discussion of State estuarine laws. In general the coastal States either have confusing laws and statutes; have regulations that are inadequate, weak, or incomplete and need the passage of additional ones or the strengthening of existing ones; or they do not dynamically enforce, coordinate, or implement the regulations that are adequate and could be effective. As evidenced by Table V.2.2 included in the preceding section on State laws, there is a surprising lack of dredge-and-fill regulations in the coastal States -- a basic use/destruction control technique.

In many coastal States, zoning responsibilities have been delegated to the local-level governments but are often not adequately supervised/coordinated by the State level, possibly because of the general absence of comprehensive management planning.

COORDINATION

In the realm of coordination, coastal States use the following mechanisms to coordinate their estuarine-related programs such as highway construction, pollution control, and various beneficial uses:

- (1) comprehensive review and/or approval of licensing or leasing applications by multiple agencies;
- (2) holding of public investigatory forums attended by various representatives;
- (3) conduct of a coordination/arbitration/reconciliation agency such as natural resources or public health agency;
- (4) establishment of written agreements providing for coordination of activities -- interstate, intrastate, and Federal;
- (5) membership by various agencies on a coordinating board or commission or the like; and
- (6) development of a comprehensive management plan that provides the guidelines for activities and actions by all appropriate agencies and amounts to a coordination mechanism.

Table V.2.3 shows the distribution among selected coastal States of coordination mechanisms. More often than not, coordination is not adequate among intrastate agencies, nor is it adequate or truly effective between the Federal and State level components.

The problems, which abound in almost every coastal State pertain to shortcomings in ability to accomplish their programs. These shortcomings center around the need for a central, strong operational/coordinating management organization, placed high enough in the State government to be effective; the need for the development and implementation of a comprehensive management plan, approved by

TABLE V.2.3
State Level Coordinating Mechanisms of Selected Coastal States

States	Licensing Review	Invest. Forum	Coord. Agency	Agree- ments	Coord. Board	Manage- ment Plan
Alaska	X			X		
California	X	X			X	
Florida			X			
Georgia				X		
Maryland		X	X			
Massachusetts	X	X	X	X		X
North Carolina			X			X
Pennsylvania	X				X	
Washington				X		

the State; and the development, passage, and enforcement of restrictive use regulations and provisions plus the need for assistance in five areas: technical, scientific, legal, administrative, and last, but not least, additional funding of estuarine-related activities. For this assistance and coordination the States look to the Federal Government (as detailed later in this chapter) but first, they must fully utilize their own capabilities.

In an evaluation such as this it is very easy to let details and complexities overshadow and even obliterate the basic concept. A simple, though often and easily forgotten basic concept or common denominator in estuarine management, is that if estuarine uses are not controlled, regulated, planned, or guided, then the undaunted exploitation, by whomever happens to be there, continues and the estuaries are not managed for the maximum benefit of the population; this is against the public interest. As expected, the States consider it to be their responsibility to control their estuarine uses. However, if this responsibility is not adequately assumed by the States then the responsibility to prompt them into action must emanate from a source other than their own initiative -- in this case, the Federal Government. The chance that the responsibilities for managing the estuaries would revert to the local level are highly remote because generally local governments have fewer capabilities than State-level governments. It follows then that if the responsibilities cannot be assumed by the State government they also

cannot be assumed by the local level. Therefore, the States themselves must act, and act quickly, to develop adequate capabilities to assume their responsibilities of forestalling further degradation of our estuarine resources.

SECTION 6. STATES' VIEWS ON COMPREHENSIVE MANAGEMENT.

HOW OPINIONS WERE OBTAINED

To help develop a true picture of the opinions and expressions of the States on the comprehensive management of the estuarine zone, the coastal States were queried directly through several routes. The National Estuarine Pollution Study staff directly and through its regional representatives asked the estuarine study representatives (appointed by the Governor) of each coastal State "What were the States' views on the composition and management of the comprehensive National programs?" The responses were received via several routes: incorporated in the State profile, prepared and/or reviewed by the States; by correspondence received directly from the Governor, his assistant or the State's estuarine representative; and/or by statements included in the record of the 30 estuarine public meetings, held in the various sectors of the Nation and attended by several thousand people. Other sources included State-prepared reports, special study (contractor) reports, and miscellaneous study documents.

The result of all these responses was a mass of information containing an extremely wide range of ideas; however, there were some prevailing ideas. The following discussion constitutes a summary of the highlights of these responses, which are being recorded and preserved separately from this report for future reference, study, use and updating.

SPECTRUM OF INTEREST

To organize and analyze the mass of information, it was necessary to develop a span of interest or a scheme for categorizing the various viewpoints of the States regarding the Federal-State-local management interplay. All of the viewpoints fell into one of three categories:

- (1) Federal-State-Local Partnership for Estuarine Management,
- (2) State Ownership/Management of Estuarine Resources with Federal Assistance, and
- (3) Autonomous State Management.

Over 91 percent of the coastal States' responses fell in the second category. The coastal States want to own/manage their own estuarine resources but with a wide range of Federal assistance -- technical, legal, scientific, administrative, and financial. Federal assistance does not necessarily mean only funds or financial support. Numerous States want advice, counsel, and guidance as to what they should do. Many States have the mechanics for managing the estuaries but often they are either not being used or not used effectively or coordinated. The States are asking for Federal assistance in interstate and intra-state matters, in order to assume effectively their expressed estuarine management responsibilities. This includes the concept that there are many administrative, technical, and research areas of a national nature that each State cannot, or probably should not cope with, or possibly should not be expected to cope with, such as the management

of estuarine resources that have a regional or national impact that extends beyond the States' boundaries. From another viewpoint the States often have State-oriented vision -- while the Federal Government can provide the national-scope overview. States can profit from others' experience through coordination at the Federal level.

Based on the general consensus of the State views, the following discussion presents the details, expressed by the States, regarding their ownership/management of estuarine resources with Federal assistance.

ROLE OF FEDERAL AND LOCAL GOVERNMENTS AND PUBLIC AND PRIVATE INTERESTS, VIEWED BY THE STATES

The coastal States believe that the Federal Government's primary role is to provide assistance to the States in conducting their activities related to the management of estuarine resources.

In general, the States expressed the viewpoint that the Federal Government should provide a wide range of assistance; this was grouped into five categories as follows: financial, scientific, technical, legal, and administrative assistance (Table V.2.4).

The provision of financial assistance from the Federal Government to the States should, according to the States, include the funding of grants-in-aid for construction; funding of development and conduct of State, interstate, and regional activities; and funding for land

TABLE V.2.4
States' Views as to Desired Federal Assistance

Coastal States	Suggested Types of Federal Assistance				
	Financial	Scientific	Technical	Legal	Admin.
Alabama	*	*	*		*
Alaska	*			*	
California				*	
Connecticut	*				
Delaware					
Florida	*	*	*		*
Georgia	*	*	*		*
Hawaii					
Louisiana	*	*	*		*
Maine	*				
Maryland	*	*	*		
Massachusetts	*	*	*		*
Mississippi	*	*	*		*
New Hampshire	*	*			
New Jersey					
New York	*	*			*
North Carolina		*	*		
Oregon			*		
Pennsylvania					
Rhode Island					
South Carolina	*	*	*		*
Texas	*				*
Virginia					*
Washington	*				
Puerto Rico	*				
Virgin Islands	*				
District of Columbia	*				

acquisition. Perhaps the Federal Government should allow bonus points as an incentive to States in implementing adequate estuarine management.

The Federal Government should provide scientific assistance to the States in the form of:

- (1) conducting demonstration projects to prove the reliability and dependability of pollution control devices or techniques, the testing of which would be too costly and would involve too much of a risk for an individual State to undertake;
- (2) defining restraints on multipurpose uses;
- (3) supporting or conducting wide-range programs including research/study that is beyond the scope of individual States (examples would be waste and water discharge rates and so forth); in addition the Federal Government should publish the resulting reports to adequately inform the States of the usable results;
- (4) reviewing Federally aided and licensed projects;
- (5) regrouping of water classes to answer area needs; and
- (6) scientific assistance in the form of managing interstate estuaries, especially in regard to research on physical and earth sciences, engineering, and biological problems.

Types of technical assistance that should be provided, or continue to be provided, to the States by the Federal Government include:

recommendations as to estuarine systems and plans; provision of model statutes and suggested comprehensive management plans; recommendations for State standards and guidelines for tidal waters; coordination of interstate studies with State plans; coordination of estuarine programs; development of investigatory techniques, specifically in aerial mapping; development and provision of training programs to provide qualified individuals to manage the diverse aspects of estuarine resources; and assistance in defining, investigating, and solving water pollution problems. Several mentioned the need for more waste treatment equipment operators.

In the area of legal assistance some States are not able to maintain adequate counsel and witnesses for the multitude of legal problems involving jurisdiction and ownership of estuarine areas and especially the definition of tidal boundaries in interstate areas. In these cases, Federal coordination in the form of legal assistance to the States is needed. States may need expert legal advice from lawyers specializing in special water laws to assist them in dealing with specific problems; however, the States may not be able to justify the retention of such impartial expert counsel, while the Federal Government can and should provide such help on request.

Last, administrative assistance is needed by the States from the Federal level. This would include increased cooperation, coordination, and backing at the Federal level to facilitate aid to States; provision of trained specialists or consulting experts to assist States in

handling specific problems that do not merit the retention of such specialists on the payroll; and provision of advice and support on administrative matters involving implementation of organizations and plans to handle estuarine management, such as adequate data processing systems; and assistance on mechanics of planning and setting up appropriate organizations.

The concept of Federal cooperation, coordination, advice, counsel, and backing to the States can be very critical and essential in those geographic areas where the estuarine resources have a regional even national impact that extends far beyond the States' borders; examples would be: the Cape Cod-Provincetown-Plymouth Rock area of New England, the New Jersey-Maryland beaches, the Florida sands, San Francisco Bay, the Louisiana and Mississippi migratory routes (flyways) and the Hawaiian Isles. The effective rational management of such national impact areas must include a consideration of the national use and preservation which is above and beyond the State-wide concept. In some cases, responsible State plans that consider the national viewpoint may have difficulty in being passed and implemented by the State-level government and population because of their reluctance to shoulder the financial burdens and responsibilities for the pleasures of the Nation. In such situations, it does not seem altogether equitable to expect the States to shoulder the entire burden, and thus the Federal Government should have available the capabilities to provide coordination, assistance, advice, counsel,

and general backing to insure a national management overview of State resources that have a national or regional impact.

Thus the Federal Government should provide, according to the States, increased coordination of its capabilities to assist the State in essentially any problem area that may arise in regard to management of their estuarine resources and to assist the States in finding the appropriate agency, program, mechanism, or procedure among the widely diversified estuarine-related programs of the numerous Federal agencies.

This viewpoint of the State (that the Federal Government should provide increased Federal-State coordination, especially in areas that are beyond the scope of the coastal States) relates to the recommendations in the Panel Reports, of the Commission on Marine Science, Engineering and Resources (V-2-G). As recommended in the Panel Report, the Commission recommends that a

" . . . National seashore boundary commission, judicial in nature, be established by the Congress with authority to hear and determine seashore boundary questions and controversies involving proprietary interests of the States under Federal grants to them, using present principles of coastal boundary determination. Such a commission should have the following characteristics and authority:

"The Congress should give its consent to State suit

against the United States, permitting States to initiate boundary cases before the commission.

"Jurisdiction of the Commission should be limited to boundary questions between the States and the United States, involving proprietary interests of the States under Federal grants to them.

"Lines determined by the commission or by the Supreme Court of the United States after an appeal would be fixed permanently. Such stabilization should apply only to ownership of submerged lands or resources, not to general political jurisdiction and authority. Authority to regulate mineral lease operations should be stabilized at the property line so determined and fixed."

The general consensus of States' views regarding the role of local-level governments is that in most cases there are not, at present, sufficient local organizations to handle estuarine management responsibilities and that the people at the local level, i.e., county, cannot support such an organization. However, whenever possible the local-level organization should be promoted and built up so that it can adequately handle the local government aspects of the State's overall comprehensive management plan for the estuaries. Local governments are often too susceptible to economic pressures and political influences in respect to estuarine development to enable them to manage the estuarine areas not only for the good

of the county but also for the good of the State; thus they should rely on implementation of the Statewide comprehensive management plans. Of course, there are notable exceptions to this, such as in New York, California, and Massachusetts. A complete discussion of the roles and capabilities of local-level governments is contained in the following Chapter 3 on local governments.

The primary role of public and private interests, as viewed by the States, is to support in each and every way possible the comprehensive management plan of the State. Without the complete cooperation of the citizenry, a comprehensive management plan cannot be effective and thus cannot effectively protect the estuarine resources.

THE STATES' ROLE -- AS VIEWED BY THE STATES

The overwhelming response from essentially all the coastal States was that they should manage their own estuarine zones; some of these responses were even, surprisingly, vehemently expressed. The remaining responses expressed by one or more States seemed to fall into five broad categories: State land ownership; cooperation/coordination of Statewide activities; State development of new comprehensive management plans; strengthening/enforcing of existing State use regulations, controls, and standards; research/study; and State use control (Table V.2.5).

Because of their unique colonial legislative prerogatives, three States in particular own their estuarine (coastal zones): Hawaii,

TABLE V.2.5
Brief Table of Viewpoints Expressed by Coastal States
as to Their Role and Responsibilities

State	State Estuarine Mgt.	Land Owner- ship	Coord. of Activ.	Develop New Mgt. Plan	Stronger Controls and Regs. on Use	Res. & Study	State Contr. Uses
Alabama	*						*
Alaska	*	*					
California	*	*	*	*			
Connecticut	*	*	*				
Delaware	*						
Florida	*						*
Georgia	*						*
Hawaii	*	*					
Louisiana	*			*			
Maine	*						
Maryland	*			*	*	*	
Massachusetts	*		*	*	*		
Mississippi	*						
New Hampshire	*				*		
New Jersey	*						
New York	*						
North Carolina	*		*		*		*
Oregon	*			*			
Pennsylvania	*						
Rhode Island	*						
South Carolina	*	*	*				*
Texas	*	*				*	*
Virginia	*		*				*
Washington	*		*	*		*	*
Puerto Rico	*					*	
Virgin Islands	*						

Texas, and Alaska. Of course, they believe strongly in State ownership of estuarine lands. Certain other States that are relatively well developed -- such as Massachusetts, California, and Connecticut -- believe in and are engaged in, ownership through acquisition by use of State funds or Federal grants.

Many of the States viewed coordination of all estuarine activities as their prerogative and also stated that cooperation/coordination of Federal-State-local-private programs was an essential element of effective estuarine management that was often sorely lacking. Some States believed that they should coordinate the Federal and private activities in their area especially because they had a better on-site overall view of the area situation than the view from the Nation's Capitol or Federal level.

However, should a State be expected to view impartially its estuarine resources that are an area-wide asset without national support? For example, the New Jersey beaches or Florida sands are enjoyed by the population far beyond each State. Their effective management involves consideration of regional significance instead of just Statewide impact. Some States even alluded to the view that more effective intrastate coordination would nullify the need for additional regulations and legislation, or even organizations.

Akin to the States' view of estuarine management was the viewpoint that they should develop a Statewide estuarine management

plan, variously termed, and an effective mechanism for enforcing it. Principally, such a plan should provide for State control of estuarine uses; that the States should control estuarine uses was definitely a prevailing view. A management organization to implement the plan should be placed high enough in the State level governmental structure so that its recommendations and actions to control estuarine uses can be effectively heard and heeded. However, the mechanism or organization may consist principally of a coordination technique, because a separate estuarine organizational entity would cut across numerous existing organizational responsibilities and probably needlessly duplicate existing delegated tasks.

Numerous States recommended that effective State management and State use control could be achieved by strengthening and enforcing existing use regulations and controls, such as strengthening dredging and spoil controls, and enforcing water quality standards applicable to tidal waters. The essential point was that the States should control/regulate estuarine uses or multiple uses.

Other States took the opposite, though related, view that the State needed to develop new regulations, controls, and provisions, such as the development of zoning plans on a Statewide basis, to govern estuarine areas. However, in general this view is essentially the same as the preceding one because States that do not have adequate estuarine management provisions should develop them and those States

that already have them should enforce/strengthen them to control the uses of estuarine areas for the mutual maximum benefit for all aspects of the population.

Last, but not least, several States believed that they should conduct area studies/research but restrict them to solving problems that exist in the local area. Research and study needs as defined not only by the States but also from numerous other sources, are elaborated separately in Part VI, Chapter 3.

In summary, the States believe they should manage and control the use, mainly through ownership or restrictive covenants, of estuarine areas. This should be done through an efficiently coordinated State-level management organization, to implement a Statewide comprehensive plan that is supportable or backed up by sufficiently strong regulations and needed research/studies designed to solve problems pertinent to the particular needs of the management organization and the corresponding estuarine resources.

SECTION 7. SUMMARY AND CONCLUSIONS

An overview of the coastal States' management framework reveals the following conditions in many areas. Many management organizations and systems are individualistic, uncoordinated, piecemeal, and short-range. Often they are burdened by noncomprehensive planning and development. In turn, the planning and development is often backed up by inadequate, confusing, not sufficiently enforced, fragmented legislation and statutory regulations.

In contrast, the coastal States have the following general views with respect to their estuarine responsibilities:

- (1) The States should manage their own intrastate estuarine (coastal) areas.
- (2) They should control or determine the uses of the estuaries, for example by zoning plans, development of preserves or "parks," or other restrictive use regulations.
- (3) They should develop, where nonexistent, a comprehensive State estuarine management plan, often by the development or strengthening of State legislation.
- (4) They should promote effective coordination and cooperation among State agencies, intrastate and interstate, for example; through commissions, councils, pacts, authorities, treaties, and agreements.

The coastal States' views on the role of the Federal Government in the management of estuaries was that the Federal-level responsibility is to "assist" the State-level estuarine (coastal) programs. In specific terms, this means that the Federal Government should:

- (1) fund (assist) State estuarine programs and activities, when needed;
- (2) conduct (assist) research and demonstration programs and projects on estuarine problems existent in the coastal States, and publish the results;
- (3) develop guidelines, suggested plans, models, or standards that reflect the national estuarine policy so that State plans and programs can be developed in harmony with the national overview; and
- (4) provide (or make available) trained scientific and technical specialists who can give advice, assistance, and counsel to, and cooperate with, the States in developing and managing their estuarine areas.

Such a general coastal States' consensus of opinion -- State-level estuarine management with Federal "assistance" -- in which the word "assistance" is used in a very wide context, would seem to offer a cooperative partnership arrangement which has been widely promulgated as the most effective mechanism for estuarine management.

Thus, the States believe they should manage and control the use, mainly through ownership or restrictive covenants, of estuarine areas. This should be done through a newer and stronger State role involving an efficiently coordinated State-level management organization, to implement a Statewide comprehensive management plan that is supportable or backed up by sufficiently strong regulations and needed research studies designed to solve problems pertinent to the particular needs of the management organization and the corresponding estuarine resources.

Summing up these viewpoints reveals two essential points:

- (1) Estuarine protective legislation cannot be effective without the corresponding organizational structure and function.
- (2) An organizational structure must have the necessary legislative authorities, staffing, and budget to give it the proper and sufficient capabilities to do the job of effectively managing the estuaries. It is useless, of course, to have an inefficient and ineffective organizational unit that is buried so deeply in the State organizational hierarchy that it is unable to do, in essence, anything.

Thus, the essential aspects of the new and improved State's role are effective legislative policy enabling protection, with a corresponding efficient organization capable of actually managing the

estuarine areas as an integral and essential part of the total water resources of the State and/or region.

Based on the above suggestions and views, and on the obvious need for a stronger and more effective State role in estuarine management, it is felt that the more effective and strengthened State role should approximate as closely as possible the following framework.

The new State role must include the exercise of primary responsibility by developing an overall Statewide estuarine management program that provides for direct, effective State management and the delegation of the requisite authority to its political subdivisions for local direction and management in accordance with the Statewide management plan.

Such a program should include:

- (1) a mechanism for its implementation.
- (2) provision for:
 - (a) coordination of State and Federal programs;
 - (b) inventory of estuarine resources;
 - (c) acquisition of selected coastal areas;
 - (d) financial assistance and coordination of research and study of area problems;
 - (e) control regulation and enforcement;
 - (f) a program of public education and awareness; and
 - (g) manpower training programs.

The needed State actions to assume their new and strengthened role are:

- (1) establishment or designation of a specific State organization provided with the authority and means to develop and implement the comprehensive phase of management for the estuarine zone.
- (2) control and enforcement of Water Quality Standards as an essential element in the long-range management plan.
- (3) consideration of legislation designed to preserve the public interest in the wetland and tidal areas. Such legislation should give authority to the State to delineate wetlands of significant natural resource value and to give them long-term protection. The State should initiate the action and should not have to wait until a particular wetland or estuary is in imminent danger of destruction.
- (4) establishment or authorization, as needed, of appropriate local/regional management organizations or special districts to provide effective implementation of the comprehensive management plan for the State's estuarine zone.
- (5) propose or work towards appropriate interstate compacts or relationships needed for management, regulation, and optimum multiple-use development in interstate waters including:

- (a) institution of State-level permit requirements for dredging, filling, or other modification of wetlands and other estuarine resources;
- (b) requirement for all State and local agencies engaged in activities that may physically or otherwise modify estuarine resources, either directly or through issuance of permits, licenses, leases, and so forth, to:
 - [1] minimize adverse effects on estuarine resources; and
 - [2] give notice of intended action and hold public hearings before acting, if there is indication that an adverse effect is a likely result;
- (c) resolution of problems in regulating use of tidal lands, wetlands, and so forth, under private ownership;
- (d) strengthening land acquisition and development programs for conservation purposes;
- (e) institution of State-level authority to review zoning and other action by local governments and to veto if inconsistent with an approved Statewide management plan; and
- (f) augmented funding of all components of the State's comprehensive management program and plan.

The management plan must also be compatible with those of neighboring States. This approach seems altogether appropriate, especially because several States have voiced concern over the anticipated loss of substantial estuarine areas during the next 5 years.

Relating the 5-year period to a protective action period indicates the following possible approach: that it would take 1 year to develop or strengthen the management plan and legislation; 1 year to get it enacted; 1 year to develop an organization; 1 year to get the organization moving; and 1 year to actually start improved estuarine management operations.

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Chapter 3

ROLE AND ACTIVITIES OF LOCAL GOVERNMENTS

SECTION 1. INTRODUCTION

The most crucial decisions on destruction and/or conservation of estuaries are made at the local government level. Yet the record of local government in estuarine management is disappointing. As Dr. Stanley A. Cain remarked, "The authority for zoned use of the Coastal Zone -- that is, its allocation to determined uses in specified places -- lies with local government. And local government finds itself weak in the face of massive private economic power and the public resistance to increased taxes" (V-3-1).

Local governments' present activities, problems, and effectiveness in the estuaries are discussed in this chapter, and ways in which local direction and programs can share in the total national effort to preserve and develop our estuaries are recommended. Particular attention is given to imaginative land and water-use management techniques by local agencies.

This discussion of local governments' role is made with full recognition that our American Federal system is one of shared responsibilities between local, State, and Federal Governments. Today there are no autonomous jurisdictions or independent functions even in the relatively neglected estuarine areas. Our functioning governmental system does not resemble a layer cake, as a common simile has it, but, more closely approximates a marble cake of joint powers and activities. Thus, rather

than allocating specific functions exclusively to local agencies, their programs can be fitted into a cooperative, intergovernmental pattern of balanced estuarine uses.

An extensive survey and enumeration of the activities of all local governments in estuaries is beyond the scope of this report. Rather, some functions of local governments relating to estuaries are briefly indicated, and their programs, problems, and regulatory tools discussed in general terms. For purposes of this report, "local government" includes not only cities and towns but also, when applicable, counties and intrastate multicounty and regional agencies.

Estuaries are affected by a wide variety of local government activities and programs, including water resources (pollution control, waste disposal, and water supply); transportation (especially port and marina facilities); conservation and recreation (parks, fisheries, and wildlife); and commercial and economic development and public and private land use (planning, zoning, and housing). All of these must be considered in organizing a comprehensive estuarine management program.

SECTION 2. MANAGEMENT TOOLS

In developing and conserving estuarine resources, the following management and regulatory tools have been used by local governments: public ownership, legislation and permits, financial inducements, zoning, planning, and public education. A discussion of these categories follows.

OWNERSHIP AND ACQUISITION

The most effective technique for conservation of estuaries is public acquisition and ownership. Although costly, government purchase of private land by negotiation (or if necessary through the power of eminent domain) is the best guarantee against estuarine despoliation. The most common form of such an open-space program is outright purchase; other variations include advance acquisition and excess condemnation. Advance acquisition is a reserved land technique by which the government purchases "land banks" before they are actually required for planned public projects in order to avoid price rises. Excess condemnation, for conservation purposes, involves the acquisition of land buffers, to maximize public access and enjoyment, near public facilities (such as small parks along highways) or schools, or between airports and residential areas.

In addition to ownership, public control may be acquired through leasing and purchasing development rights. The government can

arrange to purchase land and lease or sell it back, restricting its use (to farming or timber, for example) to preserve its open space. The Tennessee Valley Authority also uses a land covenant with restrictive provisions in it, such as prohibiting water pollution, in order to control land use (V-3-2). Additionally, the government can purchase partial rights such as scenic, conservation, or natural-resource easements. In this way, those who will not be able to sell their land for profit can be compensated. Such government contracts with private owners, however, usually do not provide for public access.

Outside funding sources can be utilized by local governments for ownership and acquisition. Federal Government revenues can be used to purchase land for seashore, parks, and wildlife refuges. The Land and Water Conservation Fund (Department of the Interior) (V-3-3) and the Open Space Land Fund (Department of Housing and Urban Development) are especially suitable for estuarine preservation (V-3-4). State aid to localities as exemplified by the New Jersey Green Acres bond issue, can be used for the purchase of marshlands. Finally, private sources often can be helpful, particularly such conservation organizations as the Audubon Society, Izaak Walton League, Nature Conservancy, and World Wildlife Fund, which have programs that use private funds and gifts. Further tax-exempt private trusts have been established to maintain coastal parks and recreational areas, as well as

golf and country clubs and private hunting preserves; such uses help protect estuaries. Despite these sources, however, local governments are still hard-pressed to find sufficient funds for acquisition.

LEGISLATION AND PERMITS

Legislation, ordinances, and permits have had varying degrees of success in regulating estuarine development. Laws prohibiting certain uses, such as disposal of untreated wastes, refuse, dredged spoils, pesticides, and other hazardous materials are common. Uses are also regulated by ordinances, such as the Los Angeles Ocean-Submerged Lands Ordinance, which sets forth detailed criteria for structures, spacing, and operations affecting estuarine development (V-3-5).

To regulate dredging or fills, permits may specify that certain requirements be met; for example, the developer must dedicate a certain portion of his shoreland for parks, pay a fee for the increased value, or fill certain designated areas; he may also be required to provide for the right of public access. Detailed conditions are often contained in dredging permits, because this sensitive operation may cause irreversible physical and biological harm to estuaries.

FINANCIAL INDUCEMENTS

Local tax policies serve as financial inducements for private owners to conserve their estuarine land by giving them more favorable terms than the standard ad valorem assessment of real property. Preferential assessment of land--evaluation at actual or current use rather than the fair market or development value--is one such technique. A second is deferred taxation, by which taxes are held back until the land is converted to a "higher" use. Grants or subsidies by local governments to the landowner so that he may pay his property tax have also been proposed as a form of rental payment to induce him to keep his land open.

ZONING

Land use controls, especially zoning, are employed by most local governments, although their effectiveness is being increasingly questioned. Zoning, or districting by permissible use, varies widely from locality to locality. Some zoning tools are use lists, density standards, and recently, performance standards (locating according to operational characteristics). Critics of this use-classification approach charge that it is unsatisfactory for land conservation purposes because it is either too rigid or allows for too many exceptions and variances. More imaginative and flexible approaches, however, such as cluster zoning, planned-unit development, and new-town zoning generally provide for

open-space planning and allow greater land protection.

Another land-use measure is subdivision control, which requires the developer to allocate a specified portion of his land project for open space or parks. A recent example of creative use of this tool is the West Islip, Long Island, New York, residential builder who dedicated one-half of his land as a wildlife refuge. Finally, flood-plain lines can be established to protect against construction of houses, while specification of bulkhead lines for private tide-lands can greatly limit dredging and filling.

PLANNING AND COORDINATION

Planning by local governments for orderly development and balanced usage of estuaries has generally been lacking. Presently, however, there are several possible means of increasing planning coordination at the local level. Section 204 of the Demonstration Cities and Metropolitan Development Act of 1966, as amended, provides that Federal grants for sewage treatment, hospitals, water supply, and transportation should be submitted for review to an areawide agency with metropolitan or regional planning authority, while Section 701 provides for such planning grants (V-3-6). In addition, Section 3c of the Federal Water Pollution Control Act, as amended, (33 USC 466) allocates funds for water quality management planning studies to local or State planning agencies designated by the Governor. Planning grants of this kind such as the one recently awarded to the Bay

Conservation and Development Commission through the State of California to curb San Francisco Bay pollution are designed to seek solutions on a basin-wide basis to reconcile the conflicting interests of polluters and other water users.

In local-State coordination, the codes of towns such as Westport and Brookhaven, New York, require that local officials approve permits for estuarine filling only after consulting with State officials. Planning studies by private organizations can be very helpful in establishing estuarine management programs. The Belle Baruch Foundation, for example, aided a survey study of Atlantic Coast wetlands which extensively mapped and evaluated the legal aspects of their ownership (V-3-7). The Conservation Foundation has also shown how new and imaginative planning and design techniques can be applied to preserve and develop Rookery Bay in Florida (V-3-8). This study illustrates the feasibility of a multipurpose estuarine conservation and development plan using the efforts of both public and private sources. Implementation of this study, however, has been delayed by the reluctance of local officials to adopt a resolution endorsing the development objectives and general recommendations of the plan.

PUBLIC EDUCATION

Although programs to educate and inform the public are of great value, they are rarely found at the local level. One significant

exception is the training of marine technicians by the city of San Diego, California. But on the whole there have been few local studies to guide developers in cost reduction by better planning of land and water use, or to acquaint developers with the benefits of open space.

SECTION 3. PROBLEMS AND FAILURES

Having briefly enumerated the management tools that local governments could employ for rational estuarine development, this section will evaluate the reasons why local governments' failures in this area outweigh their successes, recognizing at the same time that the record of the State and the Federal Governments has also been disappointing.

LEGAL PROBLEMS

The confused legal situation is a direct cause of the failure of local government in preventing uncontrolled growth in the estuaries. Divided ownership, disputed titles, unresolved public-use rights, and varying State, Federal, and local laws considerably complicate the attempt to achieve planned land-water management.

There is an urgent need for court clarification of such essential questions as: The definition of tidelands and territorial waters; can they be sold? What is the extent of public-use rights in privately owned land? When are such rights legally cut off or alienated? Which zoning regulations so restrict the use of land by its private owners to the point that these laws render the land essentially "useless" and amount to uncompensated taking of property without due process, which is unconstitutional?

These questions indicate complexities in the legal problems. Additional basic legal principles, problems and trends, existing at the State level, discussed in the preceding Chapter 2 on Coastal States Responsibilities, Programs, and Roles.

Public trust doctrines, the idea that wetlands and tidelands are held by the State for the public trust, generally have been ineffective in preserving estuarial land from sale nor did they prevent public uses from being foreclosed. Historically, tidelands were considered to be worthless property whose "reclamation" was to be encouraged. In California, for example, the State delegated ownership of much of San Francisco Bay to its bordering counties who in turn sold the land to private developers for industrial and other types of developments. In this atmosphere of permissiveness, legislative "giveaways" were encouraged and private owners easily obtained permission to wharf out or construct piers and other structures in the tidelands.

Lately, however, there has been a shift in public policy and a recognition of the irreplaceable value of such areas. Stricter regulations have been devised to limit use of these areas formerly considered to be worthless.

While the States generally control the uses of navigable waters, local governments have been delegated the prime responsibility for

managing the landward areas. There is, nevertheless, great uncertainty as to ownership, and each private title is unique and complicated. Extensive litigation over these lands, some of which have been fraudulently acquired, has been long delayed and is urgently needed. Despite the reassertion of public rights and interest in estuaries, no overall State or municipal policy on use and disposal has evolved. As a result, development is frequently unplanned and unregulated.

PROGRAM DEFICIENCIES AND REVENUE PRESSURES

A second reason for the difficulty local agencies encounter in attempting to evolve rational and comprehensive estuarine management policies is programming deficiencies. Almost all coastal local agencies lack the staff and funding capabilities to plan, decide, and implement regulations for compatible land and water uses. One survey reported that some local authorities were unaware of their jurisdiction and control powers over the coastal zone and its resources (V-3-9).

Decision making is also hampered by fragmented jurisdictions. Almost all local governments are too small to encompass the entire estuarine area; they approach problems on a piecemeal basis rather than by an overall view of the suitability of uses and the total resource value of estuaries. In addition,

local governments, including major metropolitan areas, have little impact on upstream water resource projects that can bring about major changes in the quality and amount of fresh water inflow to the estuary.

Another problem is that of coordination within local governments. As at other levels, local departments often work at cross purposes. The port development agency may favor filling estuaries at the opposition of the parks department; or the building of public-access roads by the highway department may destroy the wildlife protected by the fish and game department.

Intergovernmental relations among agencies are also haphazard. For example, rational estuarial management must integrate related land and water uses. Yet land-water zoning plans are rarely coordinated, because the State sets water quality use standards and owns the submerged lands, while the counties and local governments control the use of land bordering these waterways.

Conflicts may also occur, as illustrated by the following statement: "State and local governments frequently find themselves in adversary positions concerning conservation and recreation facilities, with local governments both hesitating to move themselves (financial limitations being the chief factor) and objecting to State action that would remove real estate from local property tax rolls or otherwise impinge on local government prerogatives" (V-3-10).

Strong economic pressures often work against preservation of estuaries. Heavily dependent on property taxes, local governments need the revenues brought in by "developed" land. Similarly, heavily taxed private land owners find selling their land to developers more profitable than retaining it in its natural state. Because of these immediate and tangible benefits and the insistence of industrial, commercial, and residential interests, it is very difficult for hard-pressed communities to conserve such things as the habitat and recreational values of the estuaries for long-range benefit. As a result of these compelling needs for revenues and profits, estuaries are dredged, filled, and developed.

The picture presented here is not encouraging: multiple fragmented units of government, inadequately staffed, desperately competing for use of the same tax base; permissive laws and regulations; few comprehensive programs; few formal mechanisms for State-local or interlocal cooperation; and little coordination of water and shoreline zoning and uses. Without local-government direction, the decision-making initiative lies within the area of private interests as more and more estuaries are destroyed.

SECTION 4. SELECTED INTERLOCAL COASTAL MANAGEMENT PROGRAMS

SAN FRANCISCO BAY CONSERVATION AND DEVELOPMENT COMMISSION

San Francisco Bay vividly illustrates the problems and promises of comprehensive estuarine management. Alarmed by this shrinking and polluted bay, the California Legislature in 1965 created the San Francisco Bay Conservation and Development Commission (BCDC).

The Act provided for a 27-member commission representing all elements of government including the cities and counties. It declared that: "The present uncoordinated, haphazard manner in which San Francisco is being filled threatens the Bay itself and is, therefore, inimical to the welfare of both present and future residents of the area surrounding the Bay" (V-3-11).

The BCDC was directed to make a detailed study of the Bay and to prepare a comprehensive and enforceable plan for its conservation and the development of its shoreline (V-3-12). It was given the power to protect the Bay during the study and planning period by issuing or denying, after public hearings, permits for all fill or excavation projects.

The BCDC study documented the deteriorating conditions and complex problems of the Bay. In 1850, before extensive diking and filling had begun, the Bay comprised about 680 square miles.

Presently, it is 400 square miles in area. Further, if all relatively shallow parts of the Bay were filled, as planned by

some interests, the Bay would consist of only 187 square miles. Similarly, marshlands and mudflats at the rim of the Bay, once totaling 300 square miles, have been reduced to 75 square miles. The Bay is especially vulnerable to land-fill projects because more than 70 percent of its area is less than 18 feet deep.

Existing political, administrative, and legal mechanisms were inadequate to protect this invaluable resource. Haphazard planning and zoning practices abounded, with each municipality operating independently of its neighbors. Ownership of the Bay was divided between the State (50 percent), cities and counties (23 percent), the Federal Government (5 percent), and private owners (22 percent), whose titles were often disputed. Moreover, there were differences of opinion on the extent of the public trust, such as whether cities could fill in lands granted to them by the State.

In January 1969, BCDC filed a final report which included the Commission's detailed study of the Bay (V-3-12). A comprehensive plan was adopted and to maintain and carry out this plan, an appropriate agency was recommended, at an estimated annual cost of \$400,000 to \$500,000. A bill, the McAteer-Petris Act as amended, implementing the BCDC recommendations and extending its life was enacted in August 1969 (V-3-13). The bill gives the commission in general terms the following powers: To analyze, plan, and regulate the entire Bay and shoreline as a unit with

jurisdiction up to 100 feet; to make an effective use of each prime site; and to grant or deny permits for all Bay filling or dredging in accordance with the standards in the plan. The commission is also able to regulate shoreline development to insure that prime sites are reserved for priority uses, to provide for maximum public access and repurchase, and to encourage attractive design of shoreline development.

In conclusion, San Francisco Bay is not unique in its estuarial problems. The picture BCDC painted of a neglected, shrinking, polluted bay, yet an irreplaceable and immensely productive resource, is typical of most of our Nation's estuaries. What is significant about the San Francisco Bay experience, in addition to the comprehensive and detailed background reports, is that this study commission was oriented toward practical planning and implementation, and that it was also endowed with interim power to prevent further despoliation and uncoordinated development. Under the act that created BCDC, this commission could grant permits for fill or excavation only if a proposed project was "(1) necessary to the health, safety, or welfare of the public in the entire Bay area, or (2) of such nature that it will not adversely affect the comprehensive plan being prepared." Thus BCDC showed how a regional agency endowed with permit powers and focusing its studies on program implementation did not merely

study the problem but also served as a catalyzing agency to preserve this irreplaceable estuary.

LONG ISLAND WETLANDS PROTECTIVE PLANS

The wetlands of Long Island have long been a cause for concern to those worried about the rapid loss of our estuaries. There is a lengthy history of political controversy over fillings and alleged dredging violations.

It has been estimated that 12.5 percent of these irreplaceable lands was lost between 1954 and 1959, and that at present 30 percent of Long Island's remaining wetlands is in immediate danger, while another 39 percent will be endangered in the foreseeable future. In addition, of 29 cases of dredging by the Corps of Engineers, undertaken between 1964 and 1966 over the objections of the U.S. Fish and Wildlife Service, 21 were in the Long Island area (V-3-14).

This has spurred legislative action on both State and Federal level to protect the rapidly disappearing estuarine resources of Long Island. In 1966 Congressman Herbert Tenzer (D. - N.Y.) of the 5th District introduced legislation to create a National Wetlands Area in south Long Island. Broadened to include other estuarine areas, House bill H.R. 15770 barely failed to pass in the 89th Congress and was finally enacted as Public Law 90-454, the National Estuary Protection Act, in 1968 by the 90th Congress.

At about the same time, New York State passed the Long Island Wetlands Act, which provides that the States and localities share the costs on a 50-50 basis of maintaining, operating, and developing county or municipally owned wetlands that have been dedicated to conservation purposes. At present 15,500 acres, mostly in the town of Hempstead, are protected and authorities plan to extend the Act's coverage to another 31,000 acres.

Also a government instrumentality has recently been created in recognition of the importance to Long Island of its marine environment. In 1965 the Nassau-Suffolk Regional Planning Board created an oceanographic committee which prepared a report of the status and potential of Long Island's marine environment with recommendations on duck and vessel pollution and on regulating marine sand and gravel dredging (V-3-15). The report also recommended a comprehensive research and planning program to remedy present management and coordination deficiencies.

Following the Committee's report, a Regional Marine Resources Council was created by the Planning Board in 1967 to act in an advisory capacity on all matters involving Long Island's marine resources on an ad hoc basis and to formulate a long-range management plan. The Council serves as an informal coordinating agency and also brings together various nongovernmental and private interests through its bi-monthly meetings. The Council is now funding a research program and has been instrumental in bringing about improved methods for

duck-farm waste disposal, elimination of DDT used as a pesticide in several areas, and greater attention to improved wetland use and sewer outfall locations.

MASSACHUSETTS LOCAL CONSERVATION COMMISSIONS

Recently, gains have been made in Massachusetts in recognizing conservation needs and effecting appropriate programs. During this time, 38 of 60 coastal towns established conservation commissions to administer to the conservation needs of the community. As stated by the 1964 Massachusetts legislature, "... the greater effort of many coastal commissions has been directed toward the protection of tidemarsh areas. Protection methods in various towns have included: establishment of dredging and filling by-laws; conservation district and/or subdivision zoning; and actual acquisition of tidemarsh acreages. Unfortunately that acquisition, the most highly desired form of protection, is being exercised in relatively few towns. The towns of Orleans and Chatham are leaders in acquisition, having procured 400 and 170 acres respectively. Acquisition in both of these towns has been by gift, purchase and eminent domain. In addition to the actual acquiring of tidemarsh acreages for conservation purposes, each of the above towns employs zoning, and dredging and filling by-laws to further regulate the use of coastal wetland areas.

"The Town of Barnstable ... designated the Great Marshes of Barnstable as the Great Marshes Conservation Area. This area comprises about

3,300 acres of tidemarsh. It is expected that the entire area will be deeded over to the Town within two or three years.

"If all coastal conservation commissions could boast of similar accomplishments the problem of our vanishing wetlands would no longer exist. To date, less than 1,000 acres of coastal wetland have been acquired at the town level of government.

"A primary goal of every coastal commission should be to acquire and place under permanent protection, at least one of its more important tidemarsh areas" (V-3-16).

SECTION 5. RECOMMENDATIONS AND CONCLUSIONS

This chapter has briefly surveyed existing practices and evaluated the accomplishments and problems of local government activities relating to estuaries. On the following pages, some recommendations are made to promote effective local programs, bearing in mind that, under our Federal system, operating success can best be achieved through cooperative local-State programs.

The purpose of these suggestions is not to freeze forever the estuaries in their present status, but rather to curb uncontrolled growth and haphazard but devastating urban incursions and to develop compatible land and water management systems that will provide for balanced use of estuaries.

First, local governments must be strengthened and reoriented to focus on estuarial problems. Carefully drafted model legislation, ordinances, and planning guides for local governments should be established to call attention to these vulnerable resources. They should include a statement of public purpose and interest along with a description of basic goals (such as open space and recreational development and the shoreline area, including wetlands and waterfront areas, to be covered). In addition to a legislative declaration of public rights and use claims, planning and regulatory authority should be given to a specific estuarine management agency. At least an interagency committee should be established to coordinate local policies.

Such legislation could establish an open space and estuarine preservation policy to control the alteration of estuaries and prohibit any pollution. Further grants of State-owned tidelands could be halted, and the State could definitely establish claim to all such lands unless it could be shown that colonial or territorial titles or special legislation had given this land to a private owner. The legislation could also designate essential areas to be preserved, or repurchased if necessary, and give the agency full planning and zoning power. Dredging or filling would not be permitted unless it was in accord with the estuarine use plan, with burden of proof on the filler or dredger that such alteration would not pollute or destroy the area.

With reference to geographic jurisdiction, it would be desirable to establish a regional agency to cover the entire estuarine problem area, because the individual municipalities or even counties may be too small. Whichever form such an areawide agency may take-- independent special district, interagency cooperative committee, or multijurisdictional planning unit--this governmental mechanism should have management responsibility as well as study and research authority. This would include regulatory power over dredging and filling, zoning and land-water use authority, and perhaps even the ability to raise revenue from licenses and to study management techniques.

The regional estuarine agency should utilize the full array of management and planning tools described earlier, including especially

the power of eminent domain with just compensation, repurchase and easement rights for public access, and development options to preserve the land. Its leases and permits should be flexible so they can be terminated or revoked should their conditions be violated. Regulations should not rigidly foreclose any further industrial, commercial or residential development. Sufficient safeguards for public representation, such as notices, hearings, and possibly an appeals board are also desirable. To survive legal attack, regulations should be reasonable and should be applied in a nonarbitrary, nondiscriminatory manner; they should not preclude some other public or private economic uses. Ideally these regulations and plans should be viewed as guides and standards, and, while restraining and controlling development, should serve as an inducement for better design and land use.

Such a multifunctional agency could also deal with hurricane, flood, and erosion control; waterfront access; architectural preservation and beautification; and upstream water projects influencing the estuarine zone. Its regulatory and policy powers could be subjected to the final decision making of a review and appeals board composed of municipal officials and group representatives. In its decision on licenses and permits, the board would be empowered to consider such factors as recreational and economic, aesthetic, and environmental effects. It is unlikely that many areas will immediately establish such a regional estuarine

management agency, but in all probability will first choose to undertake an overall survey of their estuarine problems. Such a study, however, should not be an excuse for inaction. As in the case of BCDC a moratorium on further filling and sales could be declared until the study commission reports, and the commission could be given interim permit and zoning authority, such as the power to grant dredging licenses and establish bulkhead lines.

States have an important role to play in aiding local programs. Financial assistance in the form of matching grants for pollution control or open space bond issues can be crucial in local estuarine management. In addition to funding, cooperative programs can be utilized in such areas as zoning and planning. The State may choose to establish an official map or enact a broad zoning law with general requirements to be met by county and local government plans. Permits for dredging and filling issued by municipalities could be reviewed by State natural resources commissions or wetlands boards.

Utilization of the expertise and resources of private organizations is advantageous for local governments. For example, the Conservation Foundation study of Rookery Bay, Fla., could serve as the basis for a "model estuaries" Federal-State-local grant program. Also, the Nature Conservancy fund could be used by localities to establish parks and other refuges in estuaries for public purposes.

In addition to research on biological aspects and water quality, there is a great need for further study of the legal aspects of estuarine management. Clarification of conflicting ownership claims and titles is urgently needed in almost every estuary. A detailed survey and inventory of ownerships, to include legal basis, rights, title checks, and assessment of land value, should be undertaken by local governments. It is not unlikely that such a survey would disclose land still owned by the State and leases that need renegotiation because their terms have been breached. A continuous updating of this land register should also be part of local governments' management activities.

This Chapter has stressed the crucial role that local governments can play in the direction and management of estuaries. In the past, localities have not been very effective in developing and maintaining comprehensive programs. Greatly handicapped by a lack of plans, administration, finances, and government personnel, they have been further hindered in decision making in the public interest by their limited geographic scope, taxable resources, and legal powers. In almost all cases they have failed to arouse the public or overcome popular indifference to the loss of estuaries to the encroachments of "civilization".

The record of estuarine management has been disappointing at all levels, Federal and State as well as local. The only answer to the question "Can we rely on local government?" is that we must -- for we have no choice -- work through the municipalities, counties,

and towns. Indeed only a cooperative, intergovernmental approach can succeed because each level is ineffective by itself. Regional agencies covering the estuarine zone can promise the best results, but only by strengthening the existing decision-making machinery, as suggested here, can local government rise to this challenge. Local government has the capability to play a leading role in estuarine management, and it is essential that it do so. For, ultimately, any such program must rely on local initiative, organization, planning, and support.

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Chapter 4

ROLE OF COMPACT AGENCIES IN ESTUARINE MANAGEMENT

This chapter describes and evaluates the present role of interstate and Federal-interstate compact agencies in estuarine management. It also develops recommendations concerning the role of such organizations in the comprehensive national estuarine management program.

SECTION 1. USE OF COMPACT AGENCIES TO DATE

Use of the compact instrument in managing the Nation's estuarine resources has been limited to management of water resources and management of fisheries. Included in the first category are the three pollution control compacts establishing, respectively, (1) the Interstate Sanitation Commission, (2) the Interstate Commission on the Potomac River Basin, and (3) the New England Interstate Water Pollution Control Commission. Also in this category is the multipurpose Delaware River Basin Commission.

Fisheries compacts include the regulatory Potomac River Fisheries Commission and the three advisory and research-oriented fisheries commissions for, respectively, the Atlantic, Gulf, and Pacific fisheries.

Selected details on the purposes, powers, and roles of these compact agencies in estuarine management are presented in Tables V.4.1 and V.4.2.

TABLE V.4.1
Interstate Pollution Control Compacts for Estuarine Management

Agency and Signatories	Major Purpose	Major Powers	Indication of Special Concern with Estuaries
Interstate Sanitation Commission: Connecticut, New Jersey, and New York (1936)	To abate existing pollution and control future pollution.	To order entities discharging sewage to comply with treatment requirements specified in the compact; to bring court action to compel the enforcement of the compact's provisions and its own orders; and, for the purpose of coordinating the pollution control activities of the signatories, to prepare a general plan of the most practical and economical methods of securing conformity with the standards specified in the compact.	Other than its pollution control activity, has been limited to current investigations into wetlands problems and what its role should be in that area.
Interstate Commission on the Potomac River Basin: Maryland, Pennsylvania, Virginia, West Virginia, and the District of Columbia (1940)	To abate existing pollution and control future pollution.	To compile and report on stream quality data; to engage in fact-finding and research on the treatment of wastes; to promote uniform laws, rules, and regulations; to disseminate information to the public; and to recommend waste treatment and water quality standards.	Has attempted periodically to focus public attention on problems of the tidal portion of the basin through discussion at annual or special meetings and through publication of educational materials.

TABLE V.4.1
Interstate Pollution Control Compacts for Estuarine Management - Continued

Agency and Signatories	Major Purpose	Major Powers	Indication of Special Concern with Estuaries
New England Interstate Water Pollution Control Commission: 6 New England States and State of New York (1947)	To abate existing pollution and control future pollution.	To establish water quality standards for various classifications of water use; and to review and approve the signatories' classifications of their interstate waters, tributaries thereto, and tidal waters ebbing and flowing past State boundaries in New England.	None other than the use of classifications and associated water quality standards recommended for tidal waters within its jurisdiction.
Delaware River Basin Commission: Delaware, New Jersey, New York, Pennsylvania, and the United States (1961)	Through intergovernmental cooperation, to develop and effectuate plans, policies, and projects relating to the water resources of the basin.	Are numerous and very broad. Include the power to prepare plans for all aspects of the development, use, and conservation of water and related natural resources and to implement these plans through regulation, its own operations, and other means.	Adopted water quality standards for estuarine portion of the river, developed 10-year fisheries research program which signatories are implementing - estuarine portion includes anadromous fish, shellfish and finfish investigations and study of relationship of wetlands to fishery resources. Appears to have included certain estuarine resources under its comprehensive development plan. Is preparing plans for a broad study leading to development of a plan for managing the water and related land resources of Delaware Bay specifically.

TABLE V.4.2
Interstate Fishery Compacts for Estuarine Management

Agency and Signatories	Major Purpose	Major Powers	Indication of Special Concern with Estuaries
Atlantic States Marine Fisheries Commission: 15 Atlantic coastal States (1942)	To promote better use of fisheries by developing a joint Federal-State program for promotion and protection of fisheries and by preventing their physical waste.	To promote and undertake studies; through recommendations, to coordinate the States in their exercise of regulatory power; to draft and recommend fishery legislation; to consult with and advise State administrative agencies on fishery problems; and to act as a joint regulatory agency for two or more consenting States (no States have chosen to use the agency for this purpose).	Has periodically attempted, through use of its recommendatory authority, to focus attention on damage occurring to estuaries through pollution, dredging and disposal of dredged materials, and destruction of wetlands in particular. Their efforts include (1) bibliography on estuarine studies published in 1965; (2) 1964 compilations of State laws and regulations governing dredging, filling, and other disposition of wetlands; (3) issuance of guidelines for estuarine management in 1966; and (4) present preparation of educational pamphlet on estuarine management problems.
Pacific Marine Fisheries Commission: Alaska, California, Idaho, Oregon, and Washington (1947) (Hawaii also is eligible for membership)	To promote better use of fisheries by developing a joint Federal-State program for promotion and protection of fisheries and by preventing their physical waste.	To promote and undertake studies; through recommendations, to coordinate the States in their exercise of regulatory power; to draft and recommend fishery legislation; and to consult with and advise State administrative agencies on fishery problems.	Has periodically attempted, through use of its recommendatory authority, to secure action protecting fisheries from damage caused by pollution and alteration of natural flows.

TABLE V.4.2
Interstate Fishery Compacts for Estuarine Management - Continued

Agency and Signatories	Major Purpose	Major Powers	Indication of Special Concern with Estuaries
<u>Gulf States Marine Fisheries Commission: Alabama, Florida, Louisiana, Mississippi, and Texas (1949)</u>	To promote better use of fisheries by developing a joint Federal-State program for promotion and protection of fisheries and by preventing their physical waste.	To promote and undertake studies; through recommendations, to coordinate the States in their exercise of regulatory power; to draft and recommend fishery legislation; to consult with and advise State administrative agencies on fishery problems; and to act as a joint regulatory agency for two or more consenting States (no States have chosen to use the agency for this purpose).	Has attempted, through its recommendatory authority and the leadership of its estuarine technical coordinating committee, to give particular attention to protecting the estuarine environment for the Gulf fisheries. Their efforts include service as a coordinator in Gulf-wide Federal-State inventory of estuaries, and current preparation of an educational film demonstrating the importance of estuaries to the Gulf fisheries.
<u>Potomac River Fisheries Commission: Maryland and Virginia (1958)</u>	To conserve and improve the fishery resources of the tidewater portion of the Potomac River.	To regulate, license, and tax fishing.	Has voiced concern over proposed industrial development it regards as potentially adverse in its consequences to fisheries. Otherwise, has confined its actions to matters pertaining to management of fisheries.

GENERAL ACCOMPLISHMENTS OF WATER RESOURCE COMPACTS

Accomplishments of the compact instrument in managing water (and related land) resources generally fall into two broad categories.

The first is regulation of use and/or modification of water resources covered by the compact. This too takes two forms:

(1) the enunciating or developing, by means of the compact, of a binding agreement among the signatories on basic policies which are to govern the use of the resources and (2) the implementation by a joint agency, which the compact establishes, of such basic policies through a variety of means, including action to induce or compel others to comply with these policies and direct operation of facilities and administration of resources by the compact agency itself.

The second category of accomplishments is the performance by the compact agency of services supporting resource use or regulatory programs.

Each of these accomplishments is illustrated and elaborated below.

DEVELOPMENT OF BINDING POLICIES

Use of the compact can accomplish this in one or both of two ways. Under the first method, the compact itself expresses a negotiated agreement among the signatories on basic policies which, by virtue of that enunciation, become binding upon all of them. The typical

water allocation compact is probably the best example of this type of accomplishment. Among compacts more directly involved in estuarine management, the best example is the Tri-State compact, which creates the Interstate Sanitation Commission. Here the compact itself specifies the type of waste treatment each signatory will require for each of certain classifications of water use.

Under the second form, the compact itself does not express the basic policy agreement among the signatories. Instead, each State in the compact agrees to be bound by the policy decisions which the States collectively will reach within the framework of the compact agency. Examples are the Delaware River Basin Commission in its decision on water quality standards for the Delaware River and in the policies it applied to the recent drought emergency in that basin. Also illustrative are the policies adopted by the Potomac River Fisheries Commission to regulate fishing in the waters under its jurisdiction.

In either form, this accomplishment effectively achieves program coordination between the signatories to the compact, perhaps in the only sure way possible short of transferring the responsibility for coordination to a higher level of government.

IMPLEMENTATION OF BASIC POLICIES

Use of the compact can achieve implementation of basic policy agreements among the signatories in two ways. Under the first form, the compact agency is authorized to require those proposing use of the basin's waters to obtain its prior permission. Depending on its exact authority, the agency thus is able to implement policies, either enunciated by the compact itself or which the agency itself has developed, through such means as: (1) the attaching of performance requirements as a condition to its permission to others to utilize or modify the resource, (2) the issuing of directives ordering other entities to take steps, or halt activities, specified by the agency, and (3) the initiating of court action to compel compliance by others with the agency's permits and orders. Exemplifying this accomplishment among the agencies here surveyed are the Interstate Sanitation Commission and the Delaware River Basin Commission. The former's accomplishments in this regard are limited to the prevention or abatement of pollution. In contrast, the latter's actual or potential accomplishments extend also to such matters as the withdrawal and diversion of water from the basin and to the use of water for purposes other than waste disposal.

A compact agency can implement policies, secondly, through its own direct operation of various facilities affecting water resources

or through directly administering certain resources. Although not strictly water resource agencies, examples are: the Breaks Interstate Park Commission and the Palisades Interstate Park Commission, both of which administer interstate recreational facilities; and the Port of New York Authority and the Delaware River Port Authority, both of which administer transportation facilities in interstate metropolitan areas. Although none of the agencies included in this survey has accomplishments in this area, the Delaware River Basin Commission is authorized directly to administer and operate a broad variety of estuarine-related sites and facilities.

PERFORMANCE OF SERVICE FUNCTIONS

A major objective of the States in utilizing the compact instrument has been the creation of a joint agency to support the private development and use of such resources and/or their management by the signatories or others. Although these services may not seem as prestigious or significant as the development and implementation of basic policies governing the use of water resources, such compacts too can make an important contribution to improved use and management of resources.

The nature of these supporting services varies. They include:

- (1) serving as a clearinghouse and regional forum through which the signatories gain improved understanding of one another's

objectives and needs and through which they voluntarily coordinate their respective programs; (2) planning in the sense of development by the compact agency of policies and plans of an advisory or recommendatory nature; (3) the conducting or promoting by the agency of research and studies aimed at expanding the knowledge base and thus improving management policies; (4) increasing public awareness and understanding of program needs by information dissemination and education programs; and (5) representation by the agency of State views and interests at the Federal level.

Although most compact agencies perform one or more of the services mentioned above, the programs of several of the agencies included in this review are limited to these services. Specifically, this is true of three of the fisheries compacts (Atlantic, Gulf, and Pacific); the present Potomac pollution control compact, whose agency has stressed studies, public education programs, and service as a regional clearinghouse and forum; and the New England Interstate Water Pollution Control Commission, whose activities have been characterized by advisory program planning, program coordination, research and studies, and service as a regional clearinghouse and forum.

EVALUATION OF THEIR PAST ROLE IN ESTUARINE MANAGEMENT

As shown in Table V.4.2, each of the three interstate fisheries commissions has stressed the improved use of fishery resources

as its major purpose. As part of this effort, each also has attempted to reduce the damage to estuaries through pollution and other causes. Limited in each case to a research-coordinating and recommendatory role, none of the agencies has itself been able to do much about such damage. Moreover, even in the restricted role of these agencies, their limited resources -- in money and size of the staff -- have seriously handicapped their effectiveness.

Like their counterparts in the fisheries, the three interstate pollution control agencies have not become significantly involved in estuarine management. In the case of two -- the New England Interstate Water Pollution Control Commission and the Interstate Commission on the Potomac River Basin -- authority is limited to support of State pollution control agencies. It also extends, in the case of the first agency, over a geographic area much larger than this region's estuaries. This latter point appears less important in the case of the Potomac commission, because it has shown special concern with the estuarine portion of the river. That concern, however, has almost solely stressed the pollution threat. In both of these agencies, limited financial resources also have curtailed the overall contribution which they can make.

Although concerned with what clearly are estuarine waters, the authority of the Interstate Sanitation Commission extends only to the control of pollution. Also, while it technically has

regulatory authority, this may be more apparent than real; for it can compel a polluter to take corrective action only if its order to that effect receives assent from a majority of the commissioners from each member State. Thus, a decision by the commission to order abatement of pollution, or to enforce compliance with such an order, is really a decision by the State in which the polluter is located, and the role of the interstate commission can more properly be described as ministerial in nature.

Unlike the agencies already discussed, the Delaware River Basin Commission is multipurpose in nature. Moreover, in developing a more comprehensive approach to water resource management, it can employ a broad range of authority, including regulation and operation of its own facilities. It also can exercise regulatory authority on the basis of a simple majority decision by its commissioners. Federal membership in the commission also enables it to coordinate Federal and State activities in the basin. To date, however, its concern with the estuarine resources of the basin appear to have been quite limited. It includes adoption of water quality standards for the estuarine portion of the river, the development of a 10-year fisheries research program, the inclusion of certain estuarine resources under its comprehensive development plan for the basin, and the preparation of plans for a broad study of Delaware Bay, leading to the development of a

plan for managing its water and related land resources. This limited role presumably reflects a decision to give priority to the river itself.

Although the Delaware River Basin Commission clearly has the potential to develop into a more significant force for a comprehensive approach to the management of the estuarine resources of that basin, its role in this regard can be expected to emphasize the management of estuarine water resources. This is because its authority to control land use appears to be primarily advisory and recommendatory in nature.

Compact agencies thus to date have not played an extensive or significant role in managing the Nation's estuaries. With the exception of the Delaware River Basin Commission, each agency has been predominantly concerned with a single phase of estuarine management problems. In most cases, the agency's concern with estuaries also has been only an incidental part of a broader mission. Finally, the role of most agencies -- in law or in fact -- has been restricted primarily to service to the signatory States. In other words, the States usually have stopped short of giving the compact agency real decision-making and enforcement authority on estuarine management questions and issues.

POTENTIAL ROLE IN ESTUARINE MANAGEMENT

What about the role of the interstate compact in the comprehensive national program to manage estuaries more effectively? Can, and

should, the compact instrument play a significant part in this emerging program? The answer to this second question is "yes," if two conditions are met.

First, if a compact is proposed for more than the performance of service functions, the States must in fact give their joint agency authority and resources sufficient to enable it to override each State's prerogative independently to make and carry out its own policies in its own portion of the estuary. Put differently, this condition requires that the authority and resources given to a compact agency be commensurate with its basic mission. If that mission is regulatory in the sense that the agency is to develop the basic policies that are to govern the management of a particular estuary, then the decisions of the compact agency must be binding and preclude any signatory from administering less restrictive management policies. There also must be a means of avoiding deadlocks between the signatories which stall needed decisions, and of compelling the agency to make those decisions. The latter is especially essential in situations where differences in State views concerning policy in the estuary reflect very fundamental conflicts among different uses of estuarine resources.

Similarly, if the basic mission of the compact agency also includes the implementation and enforcement of these basic policies, then its authority (1) must not be subject to the veto of a single State, (2) should include all of the usual legal powers employed

to abate pollution and other public nuisances, (3) should include the power to disallow action that is inconsistent with established policies, (4) should include authority to perform functions of a State or local agency if made necessary by the inaction of one of its signatories, and (5) should be supported by adequate financial and staff resources.

Likewise, if the agency's mission does not include either the setting or implementation of policy and is limited to that of regional service, then too its authority must be designed and supported so that the staff of the agency in fact can perform that service effectively and usefully.

The second condition is that the compact cannot be allowed to supersede or diminish Federal responsibility and authority for sound management of the Nation's estuaries. With or without Federal membership in the compact agency, a compact cannot abrogate the Federal Government's obligation to view the problems and needs of each estuary from a national perspective and to act accordingly within the limits of its authority.

Given adherence to these conditions, the compact instrument should prove to be a constructive way of achieving improved management in interstate estuaries. It also could achieve the decentralization of policy-making and administration that is essential if a major enlargement of Federal management responsibility is to be avoided.

SECTION 2. PROPOSED USES OF THE COMPACT INSTRUMENT IN THE CHESAPEAKE BASIN

THE SUSQUEHANNA AND POTOMAC COMPACTS

Both of these new compacts are concerned with the management of resources indirectly affecting the estuarine resources of Chesapeake Bay. The first, the proposed Susquehanna River Basin Compact, has been approved by Maryland, New York, and Pennsylvania, and legislation granting Congressional consent is awaiting action in the 91st Congress. The second, the proposed Potomac River Basin Compact, was drafted by a special committee established by the Governors of Maryland, Pennsylvania, Virginia, and West Virginia. It presently awaits action by the State legislatures and by the District of Columbia, which the compact includes as a member.

In brief, each compact would establish a joint agency of the signatory States and the Federal Government patterned after the Delaware River Basin Commission. Each would be empowered to perform essentially three broad functions.

The first would be to serve as a special organizational mechanism through which the basin States and the Federal Government would consult on mutual problems and interests regarding the water and related land resources of the basin.

The second function would be to coordinate the activities of these governments and of nongovernmental entities directed toward the use

and management of the basin's water and related land resources. This coordination would be achieved principally through a comprehensive water resources plan -- which would be an expression of basinwide goals, standards, objectives, programs, and projects -- to be adopted, and revised as appropriate, by the compact agency; and through the water resources program, which the compact agency would be required to adopt annually as a statement of how the comprehensive water resources plan would be implemented by the signatories, the commission, and others.

The third broad function proposed for the agency is to construct and operate necessary projects and facilities, or to undertake other desirable activities, when no other governmental agency or nongovernmental entity does so, or when the signatory parties decide that the compact agency is the most appropriate entity to do so.

Although substantially similar, the Potomac compact differs in that it would also extend the agency's authority to the preservation and promotion of, in the words of the compact, " . . . the aesthetic and other values inherent in the historic, scenic, and environmental amenities . . ." of the Potomac River Basin. The Susquehanna compact, in other words, is more strictly confined to the management of water resources.

If the new Potomac compact is enacted, the new basin agency would absorb the present Interstate Commission on the Potomac River Basin.

OBJECTIONS TO PROPOSED COMPACTS

A number of Federal agencies have voiced objections to certain features in the Susquehanna compact. As stated in WRC Agenda Memorandum #2, prepared for the Water Resources Council, these agencies are objecting to:

- (1) Voting and other provisions that could be used to adversely affect the duties and responsibilities of Federal agencies under the Federal statutes defining their respective missions.
- (2) The provision that the Federal member on the compact agency is to be ". . . the direct representative of the President. . . ." The Federal agencies object to this because the States reportedly have indicated this wording would mean that no Federal agency would be authorized to guide the decisions of the Federal member and, further, that this member could disregard the wishes of the Cabinet officers directing the Federal departments dealing with water resources.
- (3) The absence of safeguards giving assurance that the action of Federal licensing and regulatory agencies would prevail, in the event of conflict or confusion resulting from the exercise by the compact agency of comparable powers vested in it by the compact.

4. The absence of provisions requiring the compact agency to give preference to public bodies and cooperatives in the sale of hydroelectric power generated at projects constructed and operated by the agency.

Because the proposed Potomac compact follows substantially the same approach on each of the above issues, one must conclude that it will encounter similar objections from Federal agencies.

In addition, however, objections already are being raised to this compact as it is being considered for possible ratification by the State legislatures. This early opposition appears to stem from various local governments and private interests in the basin, and particularly from the West Virginia portion of the basin. Although phrased in a variety of ways, the objections seem basically to reflect the following: (1) that the interests of upstream water users are inadequately protected; (2) that local governments in the basin are subordinated to a too-powerful compact agency; (3) that there is a lack of popular or citizen control over the compact agency; (4) that the agency's regulatory authority over the use of land resources of the basin is too extensive; and (5) that the District of Columbia should not be included as a signatory equal to the basin States.

A SUGGESTED USE OF THE INTERSTATE COMPACT IN MANAGING CHESAPEAKE BAY

Proposals to utilize a compact to improve State-level management of the estuarine resources of Chesapeake Bay have been advanced from time to time. In recent years, this proposal usually has called for the enactment of a compact modeled after the Delaware River Basin Compact and the two compacts now being urged for the Susquehanna and Potomac River basins. Adherence to this approach would place the estuarine resources of Chesapeake Bay under a Federal-interstate commission empowered to perform the three broad management functions which were noted earlier in describing the latter two compacts.

As here conceived, however, the interstate compact to manage the estuarine resources of Chesapeake Bay would be an agreement between Maryland and Virginia under which each State would commit itself to take four actions:

- (1) To prepare and, after consulting with the other State, to adopt and implement a management plan for the portion of Chesapeake Bay under its jurisdiction; to prepare this plan in cooperation with local governments, the other State, appropriate Federal agencies, and others; and to include in such plan at least the following components: (a) wetlands protection and management component; (b) water quality management

component; (c) recreational use component; and (d) waterway, utilities, and industrial use component.

- (2) To establish policies and procedures whereby each State assures that its local political subdivisions will implement and comply with the plan after its adoption.
- (3) To require its agencies and local subdivisions, when developing legislative or other significant action proposals affecting the bay resources, to (a) study and consider all impacts, including the long-range effects, of the proposed action on the estuarine resources of the bay; and (b) explicitly state considerations of National, State, or local policy which justify any adverse effects that cannot be avoided by following reasonable alternatives.
- (4) To establish and maintain a joint agency in cooperation with the Federal Government that shall: (a) coordinate State and Federal research and studies in the bay and conduct its own work along these lines; (b) conduct an education program concerning issues in the use and management of the bay's resources; (c) evaluate proposed plans and projects, both public and private, for the use and management of the bay and its estuarine resources by identifying the proposal's advantages and disadvantages, weighing tradeoffs between disparate benefits involved in the proposal, pointing out effects on the

various interdependent uses of the bay's estuarine resources, and suggesting alternatives that should be considered; and (d) periodically evaluate existing management programs and the condition of the bay's estuarine resources, economic and other trends affecting those resources, and report its conclusions and recommendations to the two States and the Federal Government.

Three major objectives underline the proposed use of the compact instrument along the preceding lines.

The first is to create a governmental institution whose predominant concern and mission would be to define and clarify issues and the consequences of alternative policies for the use and management of the estuarine resources of Chesapeake Bay. Decisions on those issues and execution of those decisions would remain with the politically responsible legislative and administrative institutions of the two States and the Federal Government.

The aim would be to dramatize more effectively, to the political process which must choose among alternative ways of utilizing and managing the resources of the bay, the two central needs that are the core of sound resource management. These are, first, to eliminate or reduce the adverse spillovers from certain uses that

decrease or destroy the possibility of other use of the same resources. The need, in other words, is maximum preservation or conservation of the resource in order to maintain multiple use, and therefore maximum use, both now and in the future. The other need is to resolve the competition among different uses which results from the ever-increasing intensity of utilization, and from the inherent ultimate scarcity of some estuarine resources, through the conferring of priority on that mix of uses which society deems most beneficial, based on both short- and long-range considerations.

To facilitate the compact agency's performance of this unique function, which today is largely not performed, each signatory's membership in the agency should represent broad citizen interest and values in estuarine resources rather than those of the individual Federal or State agencies administering resource development or protection programs. It is the nature of the governmental process in this country that these line agencies as a rule must be especially responsive to special client groups. Sound management, therefore, requires that the special evaluative function here proposed for the compact agency be directed by persons not associated with the more narrow interest or viewpoint usually characteristic of these agencies.

The second objective is to obtain an agreement between Maryland and Virginia that each will develop and implement a comprehensive

plan for the use and management of its portion of the estuarine resources of Chesapeake Bay. In essence, the goal here is to apply to the resources of the interstate bay the planning and management approach that the San Francisco Bay Conservation and Development Commission has applied to, and proposed for, the resources of that intrastate estuary. (See Part V, Chapter 3 for a discussion of BCDC.) Also implicit in each State's agreement on this point would be a commitment on its part to establish a greater degree of State-level supervision and control over zoning and other local regulations over land uses within the basin that affect estuarine values. At present, of course, each State's original authority to exercise these controls itself. has largely been delegated to its local units of government. These units, not surprisingly, have wanted to promote the economic growth of the local area and improve its tax base. However, in the absence of effective review and supervision by a State agency charged with protecting estuarine resources, the result too often has been that local governments succumb to strong local pressures to proceed with poorly planned or limited-purpose development of these resources.

The third objective is to enact in each State, by means of the compact, statutory provisions requiring that all State or local legislative or other significant action proposals affecting the estuarine resources of the bay include an assessment and justification by the proposing entity of the proposal's effect on those resources and their use.

SECTION 3. SUMMARY AND CONCLUSIONS

The effectiveness of existing compact agencies in managing the Nation's estuarine resources has been limited. The reasons are basically three.

First, the predominant concern of most compact agencies in existence has been with a single phase, or at most a few of the multiple phases, of estuarine management. Single purposes that have received special emphasis are the protection of fishery resources and the prevention or control of water pollution.

Second, concern with estuarine resources in most instances has been only an incidental part of a broader assigned mission to the agency. In other words, estuarine resources and problems ordinarily have not been the agency's special point of focus.

Third, the actual role of most compact agencies -- in law or in fact -- has been predominantly one of rendering supporting services to the signatory States. The States, in other words, have continued to make and execute most of the important estuarine management decisions outside of the compact agency's framework and procedures.

The potential contributions that the compact instrument can make to improved management of estuarine resources are important,

nevertheless. They fall broadly into two categories.

(1) Regulation of use and modification of interstate estuarine resources through, first, the enunciating or developing of a binding agreement among the signatories on basic policies which are to govern the use of those resources; and, second, the implementation of such policies by the compact agency through a variety of means, including action to induce or compel compliance by others with these policies and the direct management and operation of estuarine sites and facilities by the agency itself.

(2) Performance of services supporting the use of estuarine resources or their management by the signatories.

The use of the compact instrument which this chapter has suggested in the case of the Chesapeake Bay is an example of each contribution.

For a compact device to contribute to improved management of interstate estuaries, it must meet two requirements.

(1) the authority and resources of a compact agency must be commensurate with its basic mission. It is especially essential, if a compact authorizes the signatories' joint agency to develop and implement the basic policies which are to govern the use of the estuary, that each member State in fact should subordinate its authority to that of the compact agency.

(2) the compact cannot be allowed to supersede or diminish

the Federal Government's responsibility and authority to view the problems and needs of each estuary from a national perspective and to act accordingly within the limits of its authority.

Chapter 5

VIEWS AND RECOMMENDATIONS OF THE PUBLIC AND PRIVATE SECTORS ON ROLES IN THE ESTUARINE ZONE

SECTION 1. INTRODUCTION

The Clean Water Restoration Act of 1966, in establishing the National Estuarine Pollution Study, directed that the Study be conducted in cooperation with various Federal, State, and interstate bodies, and, in addition, with "...local public bodies and private organizations institutions, and individuals...", and that "recommendations [shall be made] for a comprehensive national program for the preservation, study, use, and development of estuaries of the Nation, and the respective responsibilities which should be assumed by Federal, State, and local governments and by public and private interests." [Emphasis added.]

Much was done through appointed representatives and many briefings, consultations, and exchanges of correspondence. But, to meet the requirement of bringing the Study to the local level and to private individuals, and generally to reach all those who were not being reached by other means, it was decided to hold a series of public meetings — at least one in each coastal State — to obtain the views of all those concerned about the condition of the estuaries.

The decision was a fortunate one, in that the meetings proved to be an excellent vehicle for obtaining a comprehensive cross-section of public opinion regarding the needs of and dangers to the estuarine

zone. Attendance at the thirty meetings was good — not only in terms of number, but also in variety of organizations and individuals represented. Many statements, both oral and written, were made. Complete transcripts of each meeting were prepared, and, as a result, it is possible to extract from them a reasonably accurate report of the major concerns of those in attendance.

An additional important result of these meetings has been increased public awareness of the values and problems of the estuaries, because of the publicity given them. This has already resulted in favorable action at both State and local level to further the protection of the estuarine zone.

The public meeting proved to be an invaluable mechanism for obtaining statements of concern and recommendation from those groups and individuals who are usually left without a voice in studies of this kind. It was hoped that a variety of presentations would be made, and the success of the public meetings in this regard was far beyond anyone's expectations.

Because the public meetings were most important in bringing the Study to the attention of individuals and to private organizations, the remainder of this Chapter is devoted to an analysis of these meetings and the conclusions to be reached from such analysis.

In addition, there were other successful means of contact which resulted in a continuous flow of information. The wide diversity of

sources and methods used has been briefly described in the introduction to the Study, and is more fully delineated in the outline in Appendix A. The outline also further indicates the importance of the public meetings in reaching various groups.

There were, of course, many other sources of information used that made particular efforts to gain the views and ideas of both the public and private sectors. The report by the Panel on Management and Development of the Coastal Zone is an excellent example. This Panel of the Commission on Marine Science, Engineering and Resources held eight informal hearings in various parts of the Nation at which a total of 126 persons testified. The Panel, in addition, interviewed or corresponded with over 600 persons.

The results of the above Panel studies are discussed in greater detail in another chapter; they are noted here because of their importance as sources of public contact.

SECTION 2. PLANNING AND CONDUCT OF THE PUBLIC MEETINGS

In order to bring the planning of the public meetings as close as possible to potential witnesses, this responsibility was delegated to the six Regional Offices of the Federal Water Pollution Control Administration involved with the coastal States.

To reach as many people as possible, and to allow for the broadest possible representation, invitations were sent to organizations, business and industrial concerns and groups, and State and local government bodies; and announcements were made in the local press and on local radio stations, in an effort to encourage individual citizens to attend and speak.

Each meeting was presided over jointly by the Regional Director and by the Governor's Representative to the National Estuarine Pollution Study.

Because of the high degree of interest shown by the people in attendance, transcripts of the meetings, including written submissions, were prepared and sent to the participants and other interested persons.

Between January of 1968 and February of 1969, thirty meetings were held. A map showing the meeting locations appears in Appendix B, and the schedule of these meetings appears in Appendix C.

The meetings reached a total of 2,868 persons and groups in attendance, with 1,069 statements presented for the record. Attendance and participation involved many different types of organizations, government and nongovernment institutions, business, and individuals.

Transcripts frequently ran to 350 pages, and included a number of technical reports on the effects of pollution and on the general condition of specific estuaries, among other things.

Because the transcripts are a permanent part of the Study, it is possible to analyze them for a number of features, and report the results.

SECTION 3. METHOD OF ANALYSIS

Perhaps the hallmark of the public meetings was the tremendous volume of information and recommendations presented by the various representatives of national organizations and their local affiliates, of State and local government bodies, of academic and research institutions; and by the individuals who spoke only for themselves.

Attendance was good and varied. Testimony was most frequent from the national organizations and government bodies. Academic institutions and industry were somewhat less involved in testifying, but did present good information and recommendations. In addition, the involvement of individual citizens was most heartening.

All of these people presented input vital to the Study, and the public meeting provided the only real forum for them.

In order that the material presented at the public meetings could be reported with some accuracy, it was important that there be some means for identifying the affiliation of each speaker, and the nature of his statement.

Accordingly, the first step was to determine the kinds of representation, and the numbers of speakers within each group. After determining categories of speakers, a count was made of the speakers and total attendance within the groupings for all meetings. The four groupings selected are as follow:

Group I. National organizations and their local affiliates, local organizations, and individuals;

Group II. Academic institutions, private research firms, and scientific foundations;

Group III. Industry, users, and industrial groups; and

Group IV. Federal, State, and local government bodies.

Table V.5.1 presents the tabulation of witnesses and attendees in each of the groups, and the total number of statements and attendance.

TABLE V.5.1
Types of Groups and Participation in Public Meetings
for the National Estuarine Pollution Study

Group	Number Statements	Total Attendance
I. National Organizations and Local Affiliates, Local Organizations, and Individuals	407	746
II. Academic Institutions, Private Research Organizations, and Scientific Foundations	133	264
III. Industry and Users, and Industrial Groups	168	705
IV. Federal, State, and Local Government Bodies	361	1,153
Totals of All Groups	1,069	2,868

As will be noted, organizations (Group I, above) and governments (Group IV) were most strongly represented in statements, with users (Group III) and academic people (Group II) speaking in lesser numbers. However, governments, organizations, and industry were well represented in terms of total attendance.

After organizing the statements by type of speaker, it was then necessary to determine subject areas for the information and recommendations presented in the various statements. These subject categories were established as a series of eight questions, as follow:

- (1) What are the major uses and values of the estuaries and estuarine zones?
- (2) What are the dangers and problems in the estuaries and estuarine zones?
- (3) What have been the results of pollution, modification, and use in the estuaries and estuarine zones?
- (4) What needs to be done to restore, preserve, and protect the estuaries?
- (5) What types of research and study are needed, and how should this research be done?
- (6) What type of organization is needed to best protect, control, and manage the estuaries?
- (7) What should be the role of the State and local governments in management of the estuaries?
- (3) What should be the role of the Federal Government in management of the estuaries?

Table V.5.2 shows the number of statements responding to each question, by group, and in gross total.

As will be noted, the questions on dangers to, uses and values of, and needs to restore the estuaries received the largest numbers of replies. Slightly behind were the questions on effects of pollution and research and study needs. The questions concerning management organizations and the recommended roles of the various levels of government received considerably fewer responses.

The next step, and without doubt a most important one, was to analyze the replies to the questions in order to bring out the concerns and specific answers most frequently expressed. To do so, each of the eight questions was analyzed separately on one of the accompanying Table V.5.3 formats. The views, concerns, and answers expressed were synthesized into a few brief statements listed in the left-hand column of the Table, and then the number of statements expressing each of the views was entered by group and in total in the columns to the right side. From this process, a more-or-less priority listing of the major concerns expressed by the greatest number of participants was prepared for each question. Because most of the people attending the public meetings made several points in each statement that responded to any question or questions, the total derived by adding the responses shown on the appropriate Table V.5.3 format will be greater than the total shown for the corresponding question on Table V.5.2.

TABLE V.5.2
Responses to Each Question Received at the Public Meetings

GROUPS	QUESTIONS	Major Uses & Values	Dangers & Problems	Effects of Pollution	Needs to Be Done	Research & Study	Management Organiza- tion	Roles of State & Local Gov.	Role of Fed. Gov.
I. National Organizations and Local Affiliates, Local Organizations, & Individuals		179	196	147	194	102	85	95	95
II. Academic Institutions, Private Research Organ- izations, & Scientific Foundations		46	57	49	58	47	28	18	18
III. Industry and Users, & Industrial Groups		86	80	47	75	57	43	43	40
IV. Federal, State & Local Government Bodies		159	193	118	184	119	91	110	104
TOTALS		470	526	361	511	325	247	266	257

Tables V.5.3a through V.5.3H demonstrate this analysis for each of the eight questions for 66 percent of the public meetings.

TABLE V.5.3a

Summary of Prevailing Tone of Responses Per Type of Public/Private Group and Per Category

SUBJECT CATEGORY	DISTRIBUTION OF RESPONSES AMONG GROUPS				
	Group I Nat'l. Orgs. & Citizens	Group II Acad. Insts. & Rsc. Orgs.	Group III Industry & Users	Group IV Gov. Orgs.	TOTAL
QUESTION NO. 1 What are the major uses and values of the estuaries and estuarine zones?					
Marine food resources, including nursery and aquaculture	73	21	31	88	213
Recreation, including sport fishing and tourism	134	31	44	126	335
Natural resources, especially fish and wildlife, and the conservation thereof	102	23	27	70	222
"Multiple beneficial use"	11	5	17	13	46
Flood control and protective barrier	8	4	3	7	22
Mineral resources	0	1	3	5	9
Transportation — maritime commerce and ports	22	11	17	34	84
Water supply, including industrial	6	0	12	10	28
Waste assimilation, including thermal	5	2	6	11	24
Natural laboratory	8	4	4	3	19
Climate modification	0	0	0	2	2
Residential and industrial siting, and resulting economic benefits	41	10	23	39	113

As can be seen from Table V.5.3a, the highest use expressed is recreation, and its outgrowths of sport fishing and tourism (385). The next greatest concern was that of the natural resources, particularly the conservation of fish and wildlife (222). Following that, statements of the importance of marine food resources (213) recognized the sea to be an increasingly important source of food, and that sound conservation practices must be put into effect to prevent loss of productivity.

Also discussed by a number of participants in the public meetings were the economic values of residential and industrial development (113), and of maritime commerce and ports (84).

The term "multiple beneficial use" came up several times (46), and the concept was implied much more frequently. This is the idea that many uses can coexist and work to each others' benefit, if certain precautions are taken.

Also presented was the value of the estuary as a natural laboratory and locus for ecological research (19).

NOTE: The numbers appearing in parentheses in this and the following summaries represent the number of statements raising the point, as indicated in the accompanying Tables.

Summary of Prevailing Tone of Responses Per Type of Public/Private Group and Per Category

SUBJECT CATEGORY	DISTRIBUTION OF RESPONSES AMONG GROUPS				
	Group I Natl. Orgs. & Citizens	Group II Acad. Insts. & Rsc. Orgs.	Group III Industry & Users	Group IV Gov. Orgs.	TOTAL
What are the dangers and problems in the estuaries and estuarine zones?					
Pollution of all kinds	157	46	47	144	396
Oil and grease	20	5	4	13	
Vessel — boat and ship	38	8	7	31	
Industrial, including thermal	42	25	10	34	
Agricultural	9	7	3	16	
Municipal, especially sewage	43	19	13	46	
Inadequate waste treatment	10	7	1	9	27
Modification — sedimentation, dredging and fill, and lack of supervision over them	115	27	35	108	285
Indiscriminate development and improper land management	42	9	8	48	107
Changing water quality standards; loss of water resource	5	0	3	8	16
Multitude of agencies, laws, jurisdictions, ownerships	9	1	2	5	17
Lack of scientific data	4	4	4	6	18
Conflicting use demands and lack of planning criteria	42	11	9	28	90
Non-enforcement of laws and weak laws	5	0	4	4	13
Resource demands, especially for electricity	6	4	5	5	20
Cost of pollution control and defeat of financing bonds	3	0	2	5	10
Public attitudes towards estuaries and marshes	4	2	1	4	11

From Table V.5.3b, it can be seen that the most frequently mentioned danger was simply "pollution" (396). Most frequently stated types were municipal wastes, especially sewage (121), industrial wastes, including thermal effluents (111), vessel discharges, especially oil and grease resulting from care-less shipping and unloading methods and bilge emptying (84), oil and grease from petroleum processes, including undersea wells (42), and agricultural wastes (35).

Modification, whether manmade or natural, was the second concern (285). While it was recognized that some limited dredging and filling may be desirable, it was stated that the current methods are not adequately supervised to protect the areas in which they are carried out. Also commented upon was the problem of material carried from upriver (sedimentation). In this context, the problems of indiscriminate development and improper land management could be mentioned, as they allow land to lie unprotected for rain to wash off the topsoil and add to sediment loads (107).

Conflicting use demands and lack of planning criteria were also frequently mentioned problems (90).

TABLE V.5.3c

Summary of Prevailing Tone of Responses Per Type of Public/Private Group and Per Category

SUBJECT CATEGORY	DISTRIBUTION OF RESPONSES AMONG GROUPS				TOTAL
	Group I Natl. Orgs. & Citizens	Group II Acad. Insts. & Rsc. Orgs.	Group III Industry & Users	Group IV Gov. Orgs.	
What have been the results of pollution, modification, and use in the estuaries and estuarine zones?					
Loss of marine food potential	44	15	14	44	117
Destruction of natural resources, including fish and wild-life, and detriment to conservation efforts	101	28	31	71	231
Loss of recreation potential, including tourism	50	16	13	29	108
Loss of land value and productivity, increased erosion, and damage to buildings	18	7	3	13	41
Public health endangered	15	5	2	25	47
Destruction of seafood industry and jobs	33	15	19	39	106
Obstruction of navigation, reduction of water supply and usability, and alteration of tides, salinity, currents	14	5	7	12	38
Damage to laboratory function	0	2	0	0	
Waste heat used elsewhere to enhance growth of fish, shell-fish and beneficial plants — may work here	0	3	3	3	9
Permanent destruction of estuaries and wetlands	49	14	19	40	122
Stagnant water, mosquitoes, eutrophication and malodor	16	5	1	11	33

Table V.5.3c indicates that the most frequently mentioned result of pollution, modification, and use in the estuaries was the destruction of natural resources, especially fish and wildlife (231). Related to this effect was the depression of the seafood industry, through either killing or contamination of the species (106), coupled with the concurrent loss of marine food potential (117).

Mentioned somewhat less frequently, but perhaps having more importance, was the destruction of the estuaries themselves and their adjacent wetlands and marshes (122), for this is damage that cannot be undone.

In addition, dirty water, littered beaches, raw sewage, and other pollutants cause the area to become unhealthy (47), or at least ugly. Needless to say, these factors destroy the recreational (108), residential (41), and navigational (38) values people seek in the estuarine area.

Several witnesses, when asked to describe the results of pollution in the estuary nearest them, said, succinctly, "It stinks" (33).

TABLE V.5.3d

Summary of Prevailing Tone of Responses Per Type of Public/Private Group and Per Category

SUBJECT CATEGORY QUESTION NO. 4	DISTRIBUTION OF RESPONSES AMONG GROUPS				TOTAL
	Group I Natl. Orgs. & Citizens	Group II Acad., Insts. & Psc. Orgs.	Group III Industry & Users	Group IV Gov. Orgs.	
What needs to be done to restore, preserve, and protect the estuaries?					
Adequate waste treatment	38	12	16	29	95
Comprehensive long-range planning for management and use control -- zoning	94	24	31	73	212
Strict water quality standards enforcement	28	7	10	18	63
Legal protection, including acquisition and conservation	24	10	9	39	82
Clarification of laws, ownerships, jurisdictions, etc.	5	1	1	8	15
Public education to estuary values and need to clean up, and citizen action	28	7	2	13	50
Strong anti-pollution laws and enforcement	80	21	14	50	165
Erosion control	5	2	2	17	26
Regulation of activities, including moratorium on fill and dredging	36	8	9	33	86
Prevention of pollution, especially vessel and oil	20	4	5	22	51
Low flow augmentation	5	0	1	7	14
Improved seafood habitats and growth conditions	6	1	2	5	14
Pollution control and abatement, including air	29	7	8	34	78

Table V.5.3d demonstrates that the chief recommendation for dealing with the problems of estuarine pollution was comprehensive management, based on long-range planning and careful land and water use (212). Because one of the problems mentioned earlier was a lack of planning criteria, these would have to be developed, and a set of priorities established.

The next recommendation involved strengthening the pollution laws we now have, and enacting new ones as needed. But, more importantly, the laws, including water quality standards (63), must be enforced to be effective (165).

Other recommendations included adequate waste treatment (95), regulation of activities such as dredging (86), legal protection of the estuaries, including acquisition and conservation practices (82), pollution control and abatement (78), and public education to the values of estuaries and the consequent need to clean them up (50). Also stressed was the need to prevent pollution, especially from shipping and petroleum activity, before it has a chance to occur (51).

TABLE V.5.3e
Summary of Prevailing Tone of Responses Per Type of Public/Private Group and Per Category

SUBJECT CATEGORY QUESTION NO. 5	DISTRIBUTION OF RESPONSES AMONG GROUPS			
	Group I. Natl. Orgs. & Citizens	Group II. Acad. Insts. & HSC. Orgs.	Group III. Industry & Users	Group IV Gov. Orgs.
What types of research and study are needed, and how should this research be done?				TOTAL
Effects of pollution, especially thermal and pesticide	33	18	16	38
Comprehensive studies to assist in plan development and administration of the management program	42	16	18	38
Legal and economic aspects — effects of estuaries	6	2	4	5
Aquaculture and increased marine food production	3	0	3	4
Inventory — all features, by estuary	42	19	17	49
To develop better waste treatment methods	20	6	7	23
To determine adequacy of water quality standards	5	2	3	2
This study is a good start	0	1	2	8
Comprehensive, multi-discipline effort	0	1	0	5
By government, academic institutions, and others	9	3	1	7
By industry, at least in part	0	0	1	0
By all levels of government	5	1	1	1
By all available persons and groups, Federal coordination	2	0	1	1
With Federal funds, including FWPCA	5	0	1	2
				105
				114
				17
				10
				127
				56
				12
				11
				6
				20
				1
				8
				4
				8

One thing brought out at the public meetings, and indicated in Table V.5.3e, was that relatively little is known about estuaries — that specific knowledge is very limited. Accordingly, it was recommended that a comprehensive, estuary-by-estuary inventory be made. This would include ecologic, geologic, and hydrologic features (127).

Also felt to be a real study need was the question of the effects of pollution, and possible beneficial uses for some items now considered pollutant (105), as well as research to develop some better methods of treating and disposing of wastes (56).

In earlier questions, the problem of a lack of planning criteria and the need to develop them were discussed. A significant number of replies to this question indicated that research/study is needed for this development, and in the general area of providing assistance to developing and administering a management plan.

Generally, it was recommended that these studies be carried out as comprehensive, multi-discipline efforts (6) by as many different types of organizations as possible (20), and, frequently, with Federal funding (8). However, the majority of responses did not include recommendations as to the source of personnel or funds to accomplish the suggested studies.

TABLE V.5.3f
Summary of Prevailing Tone of Responses Per Type of Public/Private Group and Per Category

SUBJECT CATEGORY	DISTRIBUTION OF RESPONSES AMONG GROUPS				
	Group I State, Natl. & Citizens	Group II Fed., Acad., Inst., & Bus. Orgs.	Group III Industry Users	Group IV Gov. Orgs.	TOTAL
What type of organization is needed to best protect, control, and manage the estuaries?					
Cooperative Federal, State, and local government organization, possibly under a "superagency"	17	7	8	24	56
State control only	5	3	6	8	22
A type that will promote industry cooperation	0	0	3	2	5
Present organization works well, but could use more power, especially for enforcement	5	1	2	4	12
Joint State-local organization, with nongovernment representation as appropriate	5	2	6	9	22
State and/or Federal organization	7	0	0	9	16
Cooperative Federal, State, and local, with nongovernment representation, including those not involved or affected	22	3	13	17	55
Local management organization	2	3	0	5	10
A single coordinating agency	5	0	2	5	11
Joint Federal-State organization	2	0	0	1	3
Regional organization, with Federal representation	13	6	4	15	38
New State research and development agency	2	1	0	2	5

No one organizational recommendation dominated Table V.5.3f, but the general opinion was that the organization had to include representation from beyond the immediate estuarine jurisdiction (56), and should include nongovernment representation (55).

Most frequently recommended were joint, intergovernmental organizations — Federal-State-local (111), State-local (22), Federal-State (3), etc.

Also recommended, especially in the case of interstate estuaries, was a regional body, which would include appropriate Federal, State, and local government representation (38).

Several participants felt that the present system works well, but that it needs more power, especially of enforcement (12). However, these people were in the minority.

Most felt that, regardless of the nature of the management organization, it should be so established as to avoid duplication of function and effort (implied in virtually all answers).

TABLE V.5.3g

Summary of Prevailing Tone of Responses Per Type of Public/Private Group and Per Category

SUBJECT CATEGORY QUESTION NO. 7	DISTRIBUTION OF RESPONSES AMONG GROUPS				
	Group I Natl. Orgs. & Citizens	Group II Acad. Insts & Rsc. Orgs.	Group III Industry & Users	Group IV Gov. Orgs.	TOTAL
What should be the role of the State and local governments in management?					
State management, utilizing a number of control tools	40	12	21	34	107
Cooperative State-local management, including zoning and coordination; more investment	48	6	13	35	102
Local management, utilizing State and Federal assistance; State financial and technical aid to localities	16	4	6	25	51
Public education to needs and progress	3	1	2	0	6
Local installation of monitoring and waste treatment facilities; State when localities cannot	4	2	0	5	11
Cooperation with the Federal Government in management	8	3	1	12	24
State management within a national plan, and provision of input to help develop the plan	19	5	12	29	65
More State activity than present	3	1	4	6	14

Table V.5.3g demonstrates the consensus to have been that the States should play a more active role in estuarine management and pollution control than they now do (14 specifically, but implied in most of the answers).

Generally, the local responsibility was seen to be in sharing the management functions with the States (102), or in planning and effecting waste treatment and monitoring systems (11). Several said that the localities should have the primary management responsibility (51).

State management through a number of instrumentalities was recommended (107). It was also proposed that the State management program be carried out within a national plan, and that the States and localities provide input to assist in developing and, as needed, revising the national plan (65).

TABLE V.5.3h
Summary of Prevailing Tone of Responses Per Type of Public/Private Group and Per Category

SUBJECT CATEGORY	DISTRIBUTION OF RESPONSES AMONG GROUPS			
	Group I Nat'l. Orgs. & Citizens	Group II Acad. Insts. & Rsc. Orgs.	Group III Industry & Users	Group IV Gov. Orgs.
QUESTION NO. 8 What should be the role of the Federal Government in management?				TOTAL
General assistance, financial and technical	32	4	12	31
Construction assistance	9	2	5	9
Research and training grants	11	5	12	13
Operate only in interstate estuarine areas	1	0	0	2
Cooperate with States and localities for a coordinated national program	24	8	13	35
Management, when States fail to act	12	0	3	3
Minimum water quality standards and program guidelines for States to use	12	6	6	13
Strong protective action, including acquisition and activ- ity control	26	1	4	26
Federal management, States cannot handle	2	1	2	1
Publication of research results and public education to needs and progress	5	1	1	4
Continue in present role	1	1	4	3
				79
				25
				41
				3
				81
				18
				37
				57
				6
				12
				9

Table V.5.3h indicates that the witnesses generally saw the Federal role as being a backup for the States.

The backup would be provided in the form of financial and technical assistance for a number of different purposes (145), including construction (25) and research (41). It would also be in a preparedness to move in and manage the estuaries, in the event the States failed to do so (18).

As a corollary, it was recommended that the Federal Government work with the States to achieve a coordinated national effort (118). This would include the setting of operating guidelines and minimum water quality standards for use by the States (37).

It was also suggested that the Federal Government lead in taking protective and conservative action, including acquisition (37).

In a few instances, it was stated that the estuarine pollution problem was too great for the States to handle, and that the Federal Government should assume the management function (6).

SECTION 4. SUMMARY ANALYSIS OF MAJOR CONCERNS

Summarizing the major interests and concerns of the witnesses, as expressed in the replies to the first five questions, a number of factors were demonstrated, as described in the ensuing paragraphs.

The primary interests of the speakers were: the estuary as a source of food, the estuary as an ecosystem, and the estuary as a locus for leisure activity. The estuary also serves as a protective barrier against storms and flooding, and it helps to modify the climate. It is a source of commercial resources — harbors for shipping, fish and shellfish for food, minerals for industry, and water for human and industrial use.

For these reasons, the estuarine environment is considered a good place to live and work.

An additional use of the estuary is as a natural laboratory to increase understanding and knowledge of its biota and other features.

Accordingly, concern was expressed over any activity or phenomenon that acts to destroy the values of the estuary, and over the resultant damages.

The major worry was pollution of all kinds, and especially inadequately treated municipal, industrial, and vessel wastes.

Modification, whether natural or artificial, was the second concern. This would include drainage ditches used for pest control, impoundments for water supply, and fill for residential development. Related to this, and to some degree involving it, would be the problems created by indiscriminate and too rapid development and by improper land management. These concerns were expressed in terms of upriver as well as estuarine activities.

Jurisdictional and legal questions were also mentioned as being of concern, especially as they lead various authorities to a reluctance to take action and a tendency to complain that nobody is doing anything. The need to resolve these questions, and those related to the lack of planning criteria for coping with conflicting use demands, is critical.

The destruction of natural resources despite conservation efforts was a source of uneasiness for a number of witnesses, as was the related loss of marine food potential and consequent depression of the seafood industry.

Related to the shipping and water supply values was concern about phenomena reducing these uses — obstruction, salinity intrusion, and tidal and current alterations.

Because recreation was cited as a prime estuarine use, the thought of the destruction of its potential through health hazards, stagnant

water, foul odors, increased pest populations, and sheer ugliness was particularly bothersome to many of the speakers.

Among needs that concerned the participants were: long-range planning, stronger laws, enforcement of laws and water quality standards, pollution control and abatement including air, and clarification of jurisdictions. Related to several of these were recommendations for activity control, including in many cases a moratorium on dredging and filling.

Another problem brought out at the meetings was that relatively little is known about the estuaries, per se, or about the effects of many pollutants on the estuarine ecosystem and environment, nor is there sufficient background knowledge for effective use planning and administration. Research in these areas is needed.

To summarize, the chief concerns are shown in chart form below. Numbers of the items correspond to the questions which they answer, and the numbers to the right are obtained from the appropriate Table V.5.3 format.

1a. A place for leisure activity	335
1b. A habitat for fish and wildlife	222
1c. A source of food	213
2a. A pollution collector	396
2b. A place subject to modification	285
3a. Destruction of resources	231
3b. Destruction of estuary itself	122
3c. Loss of recreational value	108

4a. Mismanagement	212
4b. Weak and unenforced laws	165
5a. Lack of knowledge	127
5b. Lack of planning criteria and data	114

In discussing the areas of concern, the four groups expressed substantial agreement.

SECTION 5. SUMMARY ANALYSIS OF RECOMMENDED MANAGEMENT
ORGANIZATION AND ROLES OF THE VARIOUS LEVELS
OF GOVERNMENT

Before presenting a synthesis of recommendations on management organizations and roles, a brief summary of recommendations by the public sector (Group IV witnesses), the nonindustrial private sector (Groups I and II), and the industrial private sector (Group III) will be given, based on their replies to the last three questions.

THE PUBLIC (GOVERNMENT) SECTOR

The representatives of the various levels of government (Group IV speakers), especially State and local, provided the greatest number of answers to these questions. Some Federal personnel testified, but these were generally regional representatives of various agencies and Congressmen. Since the various governments will of necessity be directly active in any management plan, their views are particularly important.

These witnesses felt that the Federal role in management should be:

- (1) Provision of financial and technical assistance, including that specifically allocated for construction and research and training, to the States and localities;
- (2) Leadership in protective action, including acquisition and activity control;

- (3) Cooperation with the State and local governments to maximize coordination throughout the Country; and
- (4) Establishment of minimum water quality standards and operating program guidelines for the States to use as a basis for their efforts.

They saw the States' role to be:

- (1) Operation of the management plan through a number of instrumentalities;
- (2) Management within a national plan;
- (3) Cooperation with the local governments in management, including program coordination;
- (4) Provision of financial and technical assistance to local governments; and
- (5) Cooperation with the Federal Government in management.

The local role was seen to be:

- (1) Management, utilizing all State and Federal assistance available;
- (2) Cooperation with the States in management; and
- (3) Development of plans and installation of equipment for monitoring and waste treatment.

The optimal management organization was seen to be a cooperative Federal, State, and local venture, including, in many instances, nongovernment representation. Alternatives offered were:

- (1) A cooperative State-local organization with nongovernment representation as appropriate; and
- (2) A regional organization, including Federal representatives in the membership.

THE NONINDUSTRIAL PRIVATE SECTOR

The witnesses in this category, which was devised by combining Groups I and II (national organizations, etc.; and academic people), also gave frequent answers to these questions.

These speakers stated that the Federal role should be:

- (1) Provision of technical and financial assistance, including that allocated for research and training and for construction;
- (2) Taking of strong protective action, including acquisition and activity control;
- (3) Cooperation with State and local governments to coordinate the national effort; and
- (4) Management of those estuaries which the States fail to manage.

The State role was seen by the nonindustrial private sector to be:

- (1) Cooperation with the localities in management,

- including coordination of programs;
- (2) Operation of the management plan through a number of instrumentalities;
 - (3) Management within a national plan; and
 - (4) Provision of financial and technical aid to the local governments.

The witnesses saw the local role to be management, utilizing all available financial and technical assistance programs of the Federal and State governments.

The best management system was seen to be by a cooperative Federal, State, and local organization, preferably with nongovernment representatives included. As an alternative, the nonindustrial private sector would like to see a regional organization, including Federal representation.

THE INDUSTRIAL PRIVATE SECTOR

The industry and user representatives (Group III witnesses) were of two distinct types — fishermen (including shellfish harvesters) and "others". This fact is mentioned, as the fishermen had a quite different view from that of the other Group III speakers.

The industrial witnesses felt that the Federal role should be:

- (1) Financial and technical assistance, especially for research and training and for construction;

- (2) Cooperation with the State and local governments for a coordinated national effort; and
- (3) Establishment of operating program guidelines and minimum water quality standards for the States.

The fishermen were more concerned that the Federal Government:

- (1) Take strong protective action, especially in acquisition and activity control; and
- (2) Manage, as the problems were felt to be too great for the State and local governments to handle.

Industry generally wanted the State to:

- (1) Operate the management plan through a number of instrumentalities, especially water quality control;
- (2) Manage in cooperation with the local governments; and
- (3) Manage within the framework of a national plan.

The fishermen wanted only a very minor role for the States, as they felt that the States have done very little of what they could or should have been doing.

The industrial representatives saw the local role to be:

- (1) Management, in cooperation with the States; or
- (2) Conduct of the management plan, utilizing Federal and State financial and technical assistance.

The fishermen felt that the local governments should not be directly involved in management, as they are too subject to the pressure of special interest groups.

The industrial participants felt that the management organization should be cooperative Federal, State, and local, with nongovernment representation.

The fishermen did not express recommendations for a management organization.

SUMMARY OVERVIEW

Generally, it was felt that intergovernmental cooperation is needed, and that all levels of government should be represented in any organization. Several people commented on the duplication of programs and effort, not only among the various levels of government, but also within each level of government. For this reason, recommendations for a new organizational method appeared with relative frequency, although the present components could be included in the resulting new organization.

By and large, opinion was that the problem of estuarine management and pollution control is too great to be handled at one level.

Therefore, it was recommended, in several different ways, that a national program, incorporating operating guidelines and minimum water quality standards, is needed at the Federal level. In addition,

because of shortages of funds and technical capabilities at the State and local levels, the States and localities look to the Federal Government for assistance in these areas.

The States would, in most instances, conduct the management program and coordinate local activities. The major exception would be interstate or regional organizations' management of interstate estuaries, such as Long Island Sound or Chesapeake Bay. While some saw the local role as the actual management, it was more frequently seen as being cooperation with the State and the planning and development of sewer systems and waste treatment facilities, as well as monitoring for water quality maintenance. County or State government would carry out zoning and activity-regulating programs, in the view of most witnesses.

It was the contention of some of the speakers that no one type of organization would be best in all estuaries, nor would any set assignment of roles have any more validity. These people wanted to see a primary coordination of effort among the various governmental levels, and action and method dictated by conditions in the particular estuary.

Regardless of recommended management organization or roles, the primary concern was for coordination to avoid duplication of programs and functions. It was generally felt that the State and local effort and investment should be increased, and that the Federal effort

should be primarily as a backup — providing technical and financial assistance, minimum standards, and operating guidelines, and being prepared to step in and manage those estuaries which the States and localities fail to manage.

SECTION 6. SUMMARY ANALYSIS OF RECOMMENDED ROLE OF THE PRIVATE SECTOR

While the analysis of the public meetings was not designed to bring forth recommendations specifically as to action that should be taken by individuals and nongovernment organizations, institutions, and business, a number of opinions on the subject can be extrapolated from the replies to several of the questions.

Without the concerned interest of the private sector, and the citizens comprising it, no management program can succeed.

Public attitudes towards estuaries and marshlands, and the general lack of knowledge about these vitally productive areas are two of the major problems faced in the development of a management program. Therefore, there is a need for people to learn of the resources and potential of the estuaries, and the importance of the estuaries to themselves.

Accordingly, the private sector's first action should be to become informed about the values of the estuaries — to learn that an acre of estuarine marsh, without human intervention, is two to seven times as productive as an acre of cultivated farmland, and that virtually all seafood is dependent on the estuarine environment during at least part of the life cycle.

The informed private sector can be of great assistance in bringing about the kind of comprehensive long-range management plans needed by spreading information, by putting pressure on those having responsibility for the laws and ordinances required to effect such plans, by making enforcement officials aware of violations, and by supporting strong protective measures at all levels of government, among other things.

One segment of the private sector, industry, is beginning to recognize the importance of treating its wastes and acting to improve the environment of its location. Many industries have employed environmental specialists to develop programs along these lines. A number of industrial plants have spent a large amount of money to install waste treatment equipment, sometimes with tax credits or other incentives from the States. This is all to the good, but more needs to be done. Industry must fully recognize that investment in pollution control is investment in its own future.

SECTION 7. CONCLUSIONS

The public meetings, the mechanism selected to receive input from the public and private sectors that could not have been received by other means, brought forth much helpful information and many useful recommendations.

Primarily, concern was expressed about destruction and damages in the estuaries from pollution, modification, and improper and fragmented management methods, and the need to rectify these situations. Secondarily, but closely related to the foregoing, was the feeling that all segments of the public and private sectors should take a more active role in estuarine management and pollution control.

Management recommendations were diverse, but the predominant view was that the organization should include all levels of government, and nongovernment representatives, as well. The system should be essentially:

- (1) The formulation at the Federal level of minimum water quality standards and operating program guidelines for State use;
- (2) The provision of financial and technical assistance to State and local governments by the Federal Government;
- (3) The conduct of the management plan, utilizing water quality standards and operating program guidelines, by the States;

- (4) The assignment of financial and technical aid to the localities by the States;
- (5) The planning and installation of monitoring and waste treatment equipment, and the conduct of the monitoring and waste treatment activities by the local governments; and
- (6) The cooperation with the States in management by the localities.

The recommendations for the national program, discussed in length in Part III, incorporate the recommendations from this Chapter, as well as those from other sources discussed elsewhere in this Report.

APPENDIX A

REPORT OF SOURCES AND METHODS USED FOR COORDINATION AND DATA GATHERING FOR THE NATIONAL ESTUARINE POLLUTION STUDY

- I. Means of gathering information, views, opinions, and recommendations
 - A. Correspondence, consultation, and briefing — at Headquarters and Regional levels
 - B. Public meetings
 - C. Contracts for specific data gathering
 - D. Preparation of the National Estuarine Inventory
- II. Sources of information
 - A. Federal agencies having activities and interests in the estuaries, and their reports
 - B. State, interstate, regional, territorial, and local government bodies, and their reports
 - C. National organizations, including institutions and foundations
 - D. Academic community
 - E. Industrial representatives and groups
 - F. Other individuals
- III. Means of coordination with sources
 - A. Government agencies, including Department of the Interior and subdivisions
 1. Letter/memorandum request for information on programs, views, and means of coordination
 2. Direct consultation with high-level personnel

3. Assigned Study coordinator from each non-Interior agency concerned
 4. Advisory committee composed of assigned representatives from each Interior agency concerned
 5. Conferences with assigned coordinators and representatives from the agencies
 6. Input from specific requests for data to meet Inventory needs from the
 - a. Corps of Engineers
 - b. Bureau of Commercial Fisheries
 7. Input from service contracts for data to meet Inventory needs with the
 - a. Office of Business Economics
 - b. Bureau of Mines
 - c. Geological Survey
- B. States, territories, and their local subdivisions
1. State Coordinator named by Governor in reply to a request from the Secretary of the Interior
 2. Direct consultation with and data requests to the States and localities by the Directors of the coastal Federal Water Pollution Control Administration Regional Offices for the Inventory and other purposes
 3. Preparation by the Regions of State profiles including information on organizations and activities involved with the estuaries, and especially on views and

recommendations regarding a comprehensive management program and responsibilities of the various government levels — Federal, State, and local

4. State Coordinator served as co-chairman of the public meetings, and State officials testified at the public meetings

5. Local government representatives testified at the public meetings

C. National organizations

1. Appointment of representative to the Study in reply to a letter from the Secretary of Interior

2. Letter requests for information and data on programs, views, and opinions

3. Attendance at conferences, meetings, and symposia sponsored by these organizations

4. Briefings and conferences with Washington personnel of national organizations

5. Statements at public meetings by national organizations and local affiliates

6. Letters requesting views on research and study needs

D. Academic community

1. Letters, consultations, and briefings with academic members of certain national organizations

2. Attendance at conferences and symposia sponsored

by academic institutions and organizations

3. Testimony of academic personnel, both as individuals and as representatives of universities and laboratories, at public meetings

4. Letters to selected organizations requesting views on research and study needs

5. Letters and consultations at Regional level on research and study needs

6. Input from study contracts to meet general information needs with the

- a. University of Maryland
- b. Florida State University
- c. University of North Carolina
- d. University of Washington
- e. University of Rhode Island
- f. Gulf Universities Research Corporation
- g. University of Hawaii
- h. University of Alaska

E. Industrial representatives

1. Testimony at the public meetings

2. Input through meetings of the

- a. National Security Industrial Association
- b. Marine Technology Society

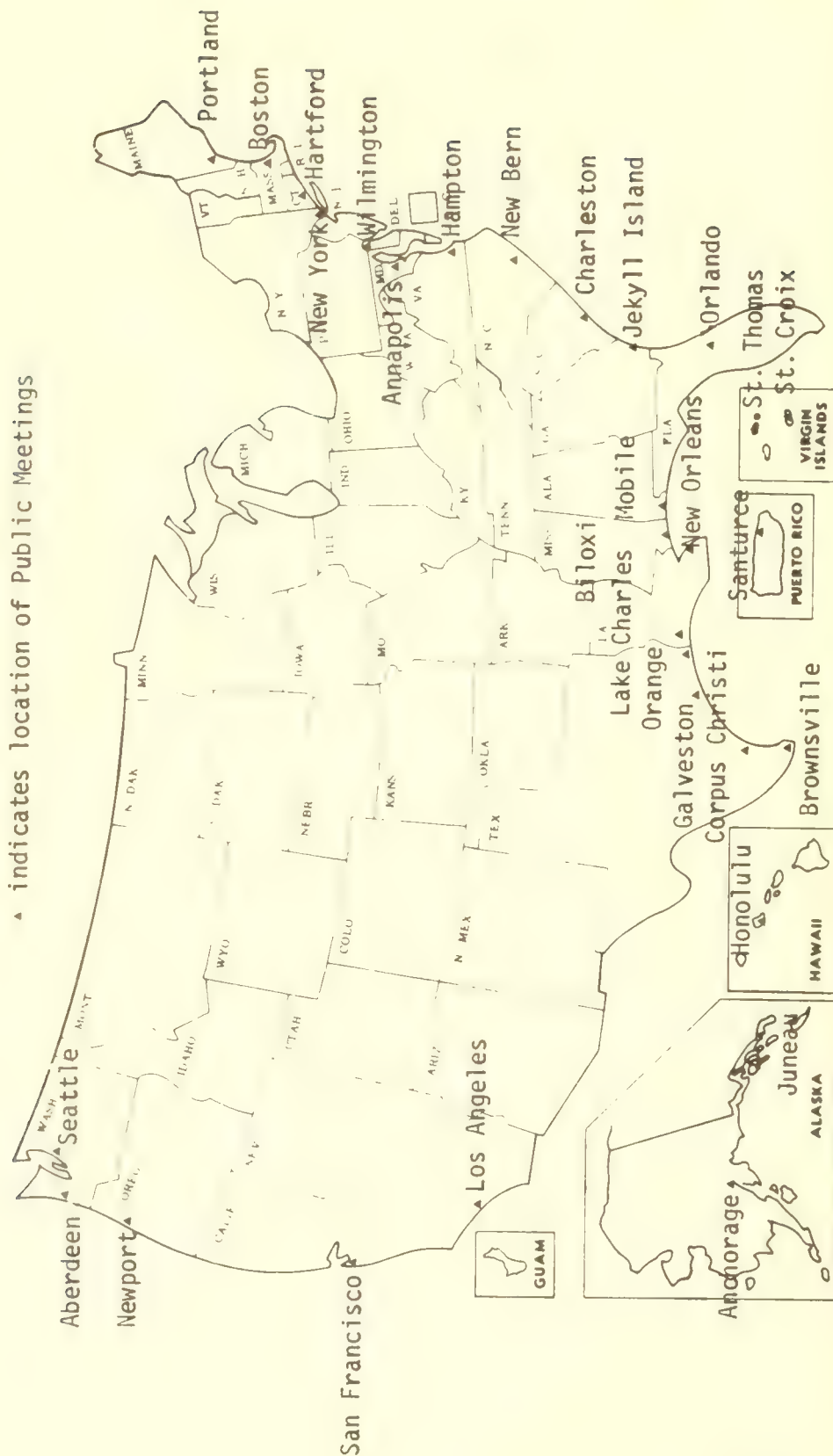
F. Other individuals

1. Testimony at the public meetings

2. Personal correspondence

APPENDIX B

MAP SHOWING LOCATION OF PUBLIC MEETINGS



APPENDIX C

SCHEDULE OF NATIONAL ESTUARINE POLLUTION STUDY
PUBLIC MEETINGS

Location of Meeting	Date of Meeting
Alabama, Mobile	November 21, 1968
Alaska, Anchorage	June 13, 1968
Alaska, Juneau	June 11, 1968
California, Los Angeles	February 25-26, 1969
California, San Francisco	February 18-19, 1969
Connecticut, Hartford	August 19-20, 1968
Delaware, Wilmington	June 27, 1968
Florida, Orlando	March 12-13, 1968
Georgia, Jekyll Island	February 29, 1968
Hawaii, Honolulu	January 28-29, 1969
Louisiana, Lake Charles	October 22, 1968
Louisiana, New Orleans	October 24, 1968
Maine, Portland	September 10-11, 1968
Maryland, Annapolis	October 30, 1968
Massachusetts, Boston	October 8, 1968
Mississippi, Biloxi	January 17, 1968
New York, New York	July 23-24, 1968
North Carolina, New Bern	July 26, 1968
Oregon, Newport	May 9, 1968
South Carolina, Charleston	June 5, 1968
Texas, Brownsville	October 1, 1968
Texas, Corpus Christi	October 3, 1968
Texas, Galveston	October 8, 1968
Texas, Orange	October 10, 1968
Virginia, Hampton	November 19, 1968
Washington, Aberdeen	July 25, 1968
Washington, Seattle	July 23, 1968
Puerto Rico, Santurce	April 22, 1968
Virgin Islands, St. Croix	April 17, 1968
Virgin Islands, St. Thomas	April 19, 1968

Chapter 6

THE ESTUARY STUDY RECOMMENDATIONS COMPARED WITH OTHER PROPOSALS FOR MANAGING THE ESTUARINE AND COASTAL ZONE

In addition to the present study, management of the coastal zone also has been the subject of one other report at the Federal level during the past year. This is Chapter 3 in the report by the Commission on Marine Science, Engineering and Resources entitled Our Nation and the Sea (hereafter referred to as Commission Report).

This chapter reviews the Commission Report in summary fashion and compares its policy recommendations with those advanced by the National Estuarine Pollution Study.

RECOMMENDATIONS OF THE COMMISSION REPORT

A major conclusion reached by the Commission is that, although, Federal, State, and local governments share the responsibility for managing estuarine and coastal zone resources, the States must be the "focus for responsibility and action." It considers, however, that effective management of these resources thus far has been thwarted by the variety of government jurisdictions involved, the low priority afforded marine matters by State governments, the diffusion of responsibilities among State agencies, and the failure of State agencies to develop and implement long-range plans. It adds that, until recently, navigation--over which Federal authority is preeminent--has tended to dominate the uses of the coastal zone, and the Commission suggests that this perhaps is the reason why the States have been slow to assume their management responsibilities.

Based on these conclusions, the Commission's major recommendations are as follows:

Establishment by the States of Coastal Zone Authorities

Each coastal State should establish one or more coastal zone authorities capable of developing and implementing management plans which would "resolve problems of competing uses" in the coastal zone. The number, form, and exact powers of these authorities would be left to each State. In general, however, the Commission expects that these authorities would be organized so as to "prevent domination by State agencies charged with narrower responsibilities." Powers to be made available to the typical coastal zone authority should include planning, regulation, acquisition and eminent domain, and development.

Planning is defined by the Commission as the making of comprehensive plans for coastal waters and adjacent lands and the conduct of necessary studies and investigations. Regulation includes zoning, the granting of easements, licenses, or permits, and the exercising of other necessary controls to ensure that use of waters and adjacent lands conforms to the plan for that area. Acquisition and eminent domain are self-explanatory. Development, as defined by the Commission, is the provision, either directly or by arrangement with other governmental agencies, of such public facilities as beaches, marinas, and other waterfront works. It includes also the leasing of estuarine and coastal zone lands.

The Commission also suggests that the States may be forced to regain zoning powers over land use which most States have yielded to local jurisdictions. Presumably, this regained authority would be exercised by the coastal zone authority (or authorities). Its report adds, "Additionally, it may be desirable to delegate to the State Coastal Zone Authorities certain regulatory functions of Federal agencies, such as reviewing proposals for construction in navigable waterways and advising Federal construction agencies."

Federal Grant Assistance

To assist the States in developing coastal zone management plans, the Commission proposes that the Federal government fund one-half of each authority's operating costs during the first two years of its existence. Matching grants also should be provided for planning studies, either through existing Federal grant programs or under new legislation. Other grant programs now available at the Federal level and applicable to other phases of the management of the coastal zone should be used to the full.

Federal Review of State Plans

In the Commission's view, the multiplicity of Federal interests in the coastal zone calls for Federal review of "proposed State plans and their implementation." This Federal review should occur at three stages: (a) when the State first proposes a particular type of coastal zone authority; (b) when the comprehensive coastal plan is submitted by the authority; and (c), if the plan is approved, when

further grants, contracts for acquisition and development, or other financing are proposed. Failure by a coastal zone authority to safeguard national interests could lead to Federal intercession, and inadequate performance by an authority could lead to withdrawal of funding support and of specific Federal functions delegated to the State.

Centralization of Federal Responsibilities

The Commission recommends that Federal responsibilities for dealing with the State authorities be centralized to assure that the Federal Government speaks with a single voice on coastal zone matters. To achieve this centralization, the Commission recommends that these responsibilities be assigned to the new National Oceanic and Atmospheric Agency (NOAA), which its report elsewhere proposes be established to secure "more effective use of the seas." Specific responsibilities which the Commission would assign to NOAA include (a) administration of Federal grants in support of the planning and enforcement activities of the State coastal zone authorities--this would include the power to revoke or withhold grants if the authorities failed to comply with plans approved by NOAA; (b) assistance to the States in the resolution of problems resulting from the divergent objectives of other Federal agencies; (c) leadership in identifying and funding the diverse research programs needed to solve the problems of the coastal zone; (d) in cooperation with other Federal agencies, development of necessary monitoring programs in the coastal zone; (e) encouragement of university research and training programs relating to coastal zone management and the support of a

system of coastal zone laboratories; (f) in collaboration with other Federal agencies, support of feasibility studies and fundamental engineering relevant to the development of offshore terminals, storage facilities, and nuclear power plants; and (g), in surveys in the coastal zone by other Federal agencies, identification of areas of common interest and coordination of plans to avoid overlap and incompatibilities.

Federal Compliance with State Plans

Other Federal agencies providing grants-in-aid to the States, or engaging in coastal activities, are to review their projects for consistency with plans adopted by the State coastal zone authorities.

Fixing of Territorial Boundaries

Congress should establish a National Seashore Boundary Commission to fix, subject to appropriate judicial review, the baselines from which to measure the territorial sea and areas covered by the Submerged Lands Act of 1953 and to determine, again subject to judicial review, the seaward lateral boundaries between the States.

COMPARISON OF COMMISSION REPORT WITH RECOMMENDATIONS IN THIS STUDY

Like the Commission Report, the Estuary Study concludes that primary responsibility for achieving sound management of the Nation's estuarine and coastal zone resources should continue to reside in the States. Consistent with that finding, it too seeks to create a Federal-State

relationship in the management of these resources through which Federal programs and activities will encourage and assist the States more effectively to discharge their primary responsibility. And like the earlier report, it proposes reliance on the grant-in-aid mechanism to achieve needed State action.

The Estuary Study also agrees with the Commission in calling for a Federal role which will influence and guide the key State-level management decisions which from here on will control the use of a State's estuarine and coastal resources. Thus it would make the grant of Federal funds to a State for administrative purposes conditional upon the State meeting three criteria imposed by the Federal Government: (1) the existence of a State organization for the management of estuarine and coastal resources not dominated either by preservation or economic development interests; (2) the capability of that organization to review Federal and federally-assisted State and local projects for consistency with the plan that organization is expected to develop; and (3) the authority within that organization to (a) require a State permit for dredging, filling, and other alteration of the lands and waters in the estuarine and coastal zone, (b) override local zoning that is inconsistent with the State plan, and (c) acquire estuarine and coastal sites which the plan earmarks for acquisition by the State.

Other recommendations in the Estuary Study similarly have the intent of achieving a role for the Federal Government which will influence State-level management decisions without usurping State management

responsibility and authority. These include (1) the recommendation that failure by a State to prepare and adhere to a comprehensive management plan should be the basis for a withdrawal by the Secretary of the Interior of additional grant support; (2) the recommended bonus attaching to the administrative grant if the State institutes an effective moratorium on further dredging and filling during the preparation of its comprehensive management plan; and (3) the comparable bonus that it recommends if that plan is acceptable to the Secretary.

The Estuary Study also concurs with the Commission Report in proposing the establishment by the Congress of a special commission to fix boundaries in the estuarine and coastal zone.

However, the Estuary Study is in fundamental disagreement with the Commission Report on the question of centralizing Federal activities in a single Federal agency. It proposes instead that coordination and integration of Federal programs and activities be the responsibility and a capability of the State organization administering or coordinating the States' estuarine and coastal zone management activities. The administration of the new Federal grants for estuarine and coastal zone management specifically would be assigned, under the Estuary Study recommendations, to the Secretary of the Interior. Existing authority of other Federal agencies basically would remain unaltered.

Other important differences between the Estuary Study and the Commission Report concern the new Federal grant programs. This study recommends an initial, one-time grant of 100 percent to each State

for use in appraising its present management program in the estuarine and coastal zone and in preparing recommendations for improving program. No such grant is proposed by the Commission. Also unique to this study are the bonus recommendations already noted in describing the grant for administrative purposes.

Other recommendations in the Estuary Study not included in the Commission Report (a) would require consideration of other resource use and management plans bearing on estuarine and coastal resources in preparing the comprehensive plan for using and managing the States' estuarine and coastal zone; (b) would direct the Secretary of the Interior to make a biennial review of problems and program needs, followed by a report to the President and the Congress; (c) would require the Secretary to establish both an interagency advisory council and a non-Federal advisory board; and (d) suggests that the President issue appropriate Executive orders and proclamations to be effective in the interim before the Congress can enact legislation establishing the National Estuarine Management Program.

Chapter 7 OVERALL ESTUARINE MANAGEMENT, A SUMMARIZATION BY CASE STUDY

SECTION 1. INTRODUCTION

Having presented in the previous Chapters of this Part of the Study the roles and programs of various levels of government, it is desired at this point to present a picture of how and how well these programs are working. To do so the case study approach has been adopted and two major estuarine zones selected for review and evaluation.

The method of operation here will be to present a reasonably complete description of the estuarine zone, its uses and resources, the major problems and dangers facing it, and conditions resulting from these. Then there will be described the programs and activities of the various levels of government being carried out in each case and an attempt to evaluate the effectiveness of these programs.

Any comprehensive program of management should contain to some extent the following elements:

- (1) Mutually agreed-upon policy objectives and functions
- (2) Legislative authorization to carry out the programs
functional activities
- (3) Development of the basic knowledge necessary for effective management
- (4) Provisions for planning and implementation
- (5) Active administration in terms of regulation, control, and coordination

(6) Financial resources

(7) Public awareness and acceptance

As it is possible the evaluation of the progress and success of management will be made in terms of the above elements.

The Chesapeake Bay on the east coast was selected as representing an interstate estuary. On the west coast, San Francisco Bay was selected as representing an intrastate estuary. The two are very different physically but the same in that they run the gamut from highly industrialized and populated areas to very rural areas. Each has a major series of problems including industrial growth, pollution, modification, and many others.

Sections 2 through 5 that follow will describe the Chesapeake Bay and its major problems, outline the activities and programs therein and make an evaluation as to effectiveness. Sections 6 through 9 will do the same for San Francisco Bay.

SECTION 2. DESCRIPTION AND USES OF THE CHESAPEAKE BAY

In describing the Chesapeake Bay and its uses we have turned to a brief but excellent work by Dr. L. Eugene Cronin, Director of the Chesapeake Biological Laboratory, Natural Resources Institute, University of Maryland (V-7-1) and quote as follows:

"Chesapeake Bay [Figure V.7.1] is about 165 nautical miles long, averages less than 20 feet deep with a maximum depth of 175 feet, and contains about 18,520 billion gallons of water. The surface area is 4300 square miles and the shoreline is 4500 miles long. The total drainage basin is 74,000 square miles. This includes the Susquehanna River, the largest on the east coast of the United States, which drains 42 percent of the basin and dominates the upper Bay The Potomac drains 22 percent of the basin and the Rappahannock-York-James complex drains about 24 percent. There are over 50 tributary rivers, with widely varying geochemical and hydrological characteristics, so that the physical circulation of the Bay is complex.

"The Bay is the drowned valley of the Susquehanna; its natural deep channels are the only remnants of the original flow-carved riverbed. It is characterized by the presence of great deposits of fine sediments in the deeper portions.



FIGURE V.7.1
Chesapeake Bay and its Principal Tributaries.
(Adapted from the report by L. E. Cronin, V-7-1.)

"Large cities, especially Baltimore, Washington and Norfolk, arose because of the Bay and increasingly impinge upon it. This is the southern end of the eastern megalopolis, with an enormous growth of population in sight.

"Salinity is near zero at the head of each tributary and at the north end of the Bay and about 30-31 parts per thousand at the Capes. Circulation is controlled primarily by river flow and the resulting density gradients. A strongly two-layered stratified system develops in summer, with a somewhat weaker winter system, and general vertical mixing occurs in spring and fall. This produces a net downstream flow of surface water and net upstream flow of deeper waters. This pattern of circulation affects many of the organisms of the Bay.

USES

"Transportation

"Ships have used the Bay since its discovery in the 16th century, and Baltimore and Norfolk are among the Nation's great ports. In 1964, 107,253,730 tons of material were handled by these ports, and Baltimore alone receives about 5,000 ocean-going ships per year. This commercial activity affects other uses of the Bay, principally through pollution by bilge-pumping and accidental spillage and through insatiable demands for the deepening and maintenance of channels.

In the main channel of the Bay, control depth is now 35 feet, but further cuts to 45 feet are now proposed.

"Biotic Yield

"Extraction of organic material from the Bay has increased from the inconsequential harvests by Indians and colonists to present efficient removal of fish and shellfish. Oyster production has been decimated by excessive exploitation, and other species have been reduced by tributary dams and pollution; but changes in gear have vastly increased the catch of menhaden, soft shell clams, and crabs. Landings for 1965 included 501,600,000 pounds of fish and shellfish for commercial use, with a value of at least \$65,000,000 (2 x dockside value). Menhaden dominated the fish catch, with 319,000,000 pounds landed, but 108,200,000 pounds of shellfish provided 74 percent of the value

"The yield to sport fishing is much more difficult to measure and evaluate. [Researchers] . . . have made valuable surveys of parts of the burgeoning recreational fishery, but no satisfactory estimates of Bay-wide effort, catch or value are available.

"In addition to these aquatic crops, the Bay area supports large populations of many species of birds and mammals. They cannot be fully reviewed here, but are of high use to the human population and affected by the changes which are occurring.

"Recreation and Esthetics

"Recreational uses of the waters of the Chesapeake Bay are very poorly documented. Boating, swimming, skiing, beaching, fishing and hunting are all increasing rapidly, but reliable data are scarce.

"Boat registration provides one helpful index. Maryland salt water boat listings increased 33 percent from 1960 to 1966. Sixty-one thousand craft are registered, about 20,000 are not required to register and about 20,000 visiting boats enter the Maryland portion of the Bay, for an annual total of 100,000. Over 300 marinas serve these boats. Virginia has a fleet of about the same size.

"The Chesapeake is the focal point of the Atlantic flyway for migratory waterfowl, and about 30 species of ducks, geese and swans concentrate there in winter. These support heavy hunting during the winter months.

"Waste Disposal

"The Baltimore-Washington metropolitan complex contained 3,771,000 people in 1960, with an expected doubling time of 25 years. While vast and expensive systems are under construction for collection of the wastes from this population and treatment to remove pathogenic bacteria and solids, almost no attention is given to the effects of pouring

increasing quantities of nitrogen and phosphorus into the Bay and its tributaries. Brehmer . . . points out that the use of the Potomac River as the final treatment stage in the Washington disposal system releases 8,000,000 pounds of phosphorus and 25,000,000 pounds of nitrogen annually into the estuary. Doubling of this quantity is predicted within 30 years, and the estuary is already badly damaged"

Thermal pollution is very rapidly increasing as power companies move to the large volumes of low-corrosion water of the estuaries. There is a complex of some 16 relatively small plants in existence now with rapid Bay-wide proliferation proposed for the near future. The new seven stations planned are designed to produce about 1,000,000 KW each and to use about 1,000,000 gallons of water per minute for condenser cooling, with a rise of 10-12°F. Some will be twice that large.

SECTION 3. MAJOR PROBLEMS AND DANGERS TO THE BAY

We have already noted in some detail two of the increasing problem areas of the Chesapeake, namely, waste loading and thermal pollution. Others that must be considered in current and future planning are as follow:

(1) The use of the Chesapeake Bay for maritime shipping results in local nuisance conditions from oil spills and overboard waste disposal. The major impact of the shipping industry is the dredging and spoil-disposal problems. The Chesapeake and Delaware Canal, a favored route for the Port of Baltimore, required an extensive dredging program in the upper Bay with attendant spoil disposal problems. Demand already exists for further deepening of the shipping channels.

The disposal of spoil in the Bay becomes of increasing concern. With the filling of deeper trenches, less salt water is able to move up the estuary in the two-layer system, changing the environment. The estuary is a natural sediment trap with most of the runoff materials deposited within it, with very little reaching the Continental Shelf. Spoil disposal practices of large magnitude will greatly accelerate the filling of deeper trenches of the Bay, not of immediate concern for shipping, but possibly significant in its effects on hydrography and ecology. The deep trenches are known to be wintering areas for certain commercial finfishes.

More recently the problem of the toxic nature of spoil from industrialized Baltimore Harbor has raised the question of immediate toxic effects in disposal areas.

(2) Altered salinity patterns in the Bay are due to diversion of fresh water to the Delaware Basin through the deepened Chesapeake and Delaware Canal and because of increased potable water needs in the Delaware Basin. The use of the Susquehanna River at the Conowingo Dam for hydroelectric purposes causes problems of low flow with the resultant intrusion of salinity further up the Bay.

(3) Aquatic plants such as wild celery, coontail, sea lettuce, Eurasian milfoil, and water chestnut have been found in the Chesapeake Bay area. At times some of these aquatic plants have increased in such abundance they created navigational problems, choked out desirable waterflow plants, interfered with shellfishing and finfishing, discouraged swimming, and created suitable breeding grounds for mosquitoes.

(4) Shoreline erosion control is [most certainly] another significant problem. Shoreline erosion can be a major source of sediment where headlands of easily eroded material are subject to wave attack.

Today, pressures for the varied use of Chesapeake Bay are more intense than ever before. An increasing population looks toward the Bay for new habitable areas and recreational facilities, and as a conduit for the disposal of wastes. Nevertheless, the very factors which make the

Bay more valuable for some human uses threaten to dissipate other resources. The filling of wetlands, the disposal of municipal and industrial wastes, the deposition of spoil from channel dredging, and thermal discharges all tend to diminish the Bay's usefulness as a commercial source of fish, shellfish, and crabs; and as a site for waterfront housing, swimming, boating, and hunting.

Returning to a quote from Cronin (V-7-1), he states that:

"Prospects are that . . .

"Nutrient pollution from domestic waste poses the greatest of all recognized threats to the Chesapeake. It will seriously change and partially destroy local areas, and there is no assurance that it will not ultimately damage major portions of the Bay and its tributaries."

SECTION 4. PROGRESS IN CURRENT MANAGEMENT ACTIVITIES

In Chapter 1, the Federal Role and Activities in the Estuarine Zone, were described and a general outline of such activities was presented in table form. In addition, the weaknesses and the needs of the Federal program were noted. In Chapter 2, the Management Activities of the States and the Problems Facing Them, were discussed in considerable detail. With this in mind, it is intended to present here for later evaluation what appears to be progress in management; namely, organization - planning - implementation, and the knowledge-gathering activities necessary for effective support.

MARYLAND

(1) Maryland has this year created a Department of Natural Resources responsible for policies, management, administration and research, and study in the area of natural resources. Among other things, this Department is responsible for the coordination and direction of Comprehensive Planning.

This in itself should be a most effective step in meeting recommendations in FWPCA's legal study of the Bay (V-7-2).

The recommendations noted were "the need for a single agency within the State to control and regulate water and related land resources, and the need for a comprehensive plan".

(2) Water Quality Standards have been adopted and approved by the Secretary of the Interior.

(3) There is in preparation a comprehensive plan for the Bay and its related resources--coordinated under the State Planning Department--possibly to include the inventory of Maryland's wetlands as directed by House Resolution No. 2 of 1967.

(4) Planning is going forward for a Statewide waste control and acceptance plan.

(5) Zoning or the control of land use adjacent to the estuarine waters is not yet well established except in and near large metropolitan areas; nor does it appear to be planned--which, of course, is on the negative side of progress.

(6) Maryland has a form of dredge, fill, and alteration control in its navigable waters, but the controls are considered weak.

(7) Regional planning appears effective, but like zoning is confined to the metropolitan areas, i.e., "Baltimore Regional Planning Council" and "Metropolitan Washington Council of Governments"--both of which plan and coordinate waste disposal problems in their areas of concern.

(8) The research and study to support improved management activities is proceeding as is shown by a quote from L. Eugene Cronin (V-7-1):

"Research has expanded rapidly on the problems and potentials of the Chesapeake area. The Chesapeake Biological Laboratory of the University of Maryland, the Virginia Institute of Marine Science, and the Chesapeake Bay Institute of the

Johns Hopkins University not only maintain substantial institutional research and training programs but have also formed the Chesapeake Research Council This brings together a total staff of about 110 scientists, 40 of whom hold doctorates, to share information and to undertake cooperative research projects. The Council is probably the largest aggregation of estuarine scientists in the world. The first joint venture utilizes six vessels for simultaneous sampling of the Bay and its tributaries. These laboratories have, since the 1930's and 1940's, provided a considerable flow of information on estuarine hydrography, ecology, geology, sport and commercial fisheries, and pollution"

VIRGINIA

- (1) The Department of Water Resources is to prepare a comprehensive plan for the water resources and development of the State.
- (2) A basin planning program for the James River Estuary is being completed.
- (3) Water Quality Standards have been adopted and approved by the Secretary of the Interior.
- (4) As in Maryland, zoning or the control of land use adjacent to the estuarine zone is confined to the metropolitan areas.

(5) Virginia does not have State permit control of dredge, fill, and alteration in its navigable waters.

(6) Virginia regards the Virginia Institute of Marine Sciences (VIMS) at Gloucester Point as its key agency in the marine environment. As noted above, VIMS is a member of the Chesapeake Research Council.

(7) Regional planning and organization are, as in Maryland; generally only active in or near metropolitan areas. Examples are:

(a) Hampton Roads Sanitation District Commission to serve Hampton, Norfolk, Virginia Beach, and Chesapeake.

(b) Alexandria Sanitation Authority to serve Fairfax County and the City of Alexandria.

(c) Virginia Beach Erosion Commission to serve the City of Virginia Beach.

(d) Southeastern Virginia Regional Planning Commission which includes Suffolk City, Virginia Beach City, and Nansemond County.

(e) Richmond Regional Planning Commission which includes Richmond City, Chesterfield County, and Henrico County.

(f) Peninsula Regional Planning Commission which includes Hampton City, Newport News, James City, Williamsburg County, and York County.

INTERSTATE ACTIVITIES

There are a number of interstate activities and agencies in the Chesapeake Bay area each of which serves to some extent to coordinate both Federal and State programs and operations.

These include the:

- (1) Interstate Commission on the Potomac River Basin created by the Potomac River Basin Compact in 1939. Members include Maryland, Virginia, West Virginia, Pennsylvania, the District of Columbia, and the United States.
- (2) Potomac River Fisheries Commission established by the Potomac River Compact, 1958, includes both the States of Maryland and Virginia. The work of the Commission provides for research, regulation, and licensing with respect to fish and shellfish, and the taking or catching of such fish in the tidewater portion of the Potomac River.
- (3) Atlantic States Marine Fisheries Commission created in 1941, includes the States of Virginia and Maryland among the fifteen signatory States to this compact. The U.S. Fish and Wildlife Service of the Department of the Interior is the primary research arm of the Commission. The purpose of the Commission is to recommend and coordinate legislation and general exercise of police powers with respect to marine, shell, and anadromous fisheries.
- (4) Chesapeake Research Council includes members such as the Virginia Institute of Marine Science, Chesapeake Bay Institute

of Johns Hopkins University and the Chesapeake Biological Laboratory of Natural Resources Institute of the University of Maryland. Its purpose is to promote and coordinate research on Chesapeake Bay.

(5) DELMARVA Advisory Council is primarily concerned with economic development. In particular, it coordinates and promotes travel and industrial development in Delaware, Maryland, and Virginia.

(6) Atlantic Waterfowl Council includes all the Atlantic Seaboard States as well as Pennsylvania, West Virginia, and Vermont. Its main activity is the protection of marine waterfowl habitat and the regulation of migratory waterfowl routes.

(7) Four-State Study Group includes the States of New Jersey, Delaware, Maryland, and Virginia. Its main function is the coordination of research on MSX oyster disease and related marine environment.

Two of the most significant management schemes that are now being considered for the Chesapeake Bay region are the proposed Federal-interstate compacts for the Susquehanna River Basin and the Potomac River Basin.

Both are modeled after the well-known Delaware River Basin Compact of 1961, and concern the use of water and related land resources, and encompass all management functions including comprehensive planning, regulation, construction, financing, maintenance, and operation of public facilities. Both stop short of entering Chesapeake Bay.

SECTION 5. EVALUATION OF THE CHESAPEAKE BAY

In the introduction, the various elements that should be considered in any comprehensive plan of management were listed and the evaluation of management in the Chesapeake Bay that follows is made in reference to those elements.

POLICY AND OBJECTIVES

First, in regard to mutually agreed-upon policy and objectives, some exist at the State level; but it would appear that an overall national policy coupled with objectives should be established at the national level. There is need for such guidance not only for State management, but to provide better objectives for interstate programs of management.

LEGISLATIVE AUTHORIZATION

At the State level Maryland's recent creation of its Department of Natural Resources has very likely produced an excellent start in this direction. Nevertheless, because of the many unsolved problems, stronger State legislation may still be needed. As was pointed out in Chapter 1, a study of the Federal programs, a stronger, more effective Federal role is needed to provide not only much greater technical assistance to the States, but also to provide the impetus and the objectives for better and more effective management. A review of the Chesapeake only verifies this. Progress is apparent, but legislative action is needed to provide a stronger and more far-reaching program.

DEVELOPMENT OF BASIC KNOWLEDGE

There exists a reasonably good understanding of the knowledge gaps that need to be filled to provide a better grade of technical knowledge. Research goes forward on many fronts and appears to be well directed towards the principal problems of the Bay.

Augmentation of research and study is no doubt needed if we are to stay ahead of the developing problems. A better coordination of the Federal research and study programs, possibly through the establishment of a multi-bureau/department estuarine laboratory devoted both to overall study of the Bay and to its individual problems is needed. The Chesapeake Bay Research Council at the State level is an excellent vehicle for coordination and cooperative exchange of information.

PLANNING AND IMPLEMENTATION

As for planning, there has been much of it at many levels, but as yet there are no overall comprehensive plans for the administration of the Bay. The State of Maryland is moving in this direction. Virginia's long-range study will help. The Corps of Engineers' study authorized in 1965 is not yet properly funded. It could, if carried to completion, include the authorized hydraulic model and give much assistance to State comprehensive plans and their implementation.

ACTIVE ADMINISTRATION--REGULATION, CONTROL, AND COORDINATION

It can only be said, that, although progress is being made, regulation and control are fragmented and less than fully effective. What is available cannot be applied in terms of the needs of comprehensive plans, because these do not yet exist. Again, there is needed the single State organization with the authority and the resources to effectively administer the many good but uncoordinated programs. In addition to the lack of a comprehensive plan, neither Virginia nor Maryland has effective State control over dredge, fills, and alteration in the wetlands and navigable waters at the present time. Neither is there zoning nor other control over the use of the adjacent lands except at the local level. Even at this level the amount of control is quite limited.

FINANCIAL RESOURCES

There has been steady growth in the personnel and financial resources devoted to estuarine management; nevertheless, considerable augmentation will be needed if comprehensive plans are to be made and implemented.

PUBLIC AWARENESS AND ACCEPTANCE

There is a considerable amount of public awareness and interest in the management of the Chesapeake Bay as was evidenced by attendance

at the public meetings sponsored by this Study, and by other meetings and symposia. There is still much to do in obtaining public participation in the decisions to be made. This is particularly necessary at the level of local government where the important decisions on land use are made. Public participation in St. Mary's County, Maryland, decisions on locating a new oil refinery on the shore of the Potomac, is an excellent example. Increasing public interest and action and understanding of the estuarine zone and its long-term value are necessities.

SECTION 6. DESCRIPTION AND USES OF THE SAN FRANCISCO BAY*

San Francisco Bay and delta comprises an extensive system of shallow interconnecting channels and bays. Its water quality ranges from sea water at the Golden Gate to fresh water at the upstream areas of the delta suitable for a variety of uses.

By its location and natural features the Bay system from Spanish times to the present has been a hub of commerce and a defense center, regional first, and national later. With growth there were added the recreational values of the immediate area and the national parks to which the area gave access, and the beginning of an industrial sector. With post World War II development, the industrial sector became a major component of the economy.

The Bay is a single body of water, with a total area of 480 square miles and a shoreline exceeding 276 miles, which receives drainage from a 50,000 square mile area. Although the Bay is a single body of water, its appearance varies greatly from one part to another. To present an adequate or even a reasonably complete description of the Bay with its massive variety in terrain, appearance, condition, and general development is almost an impossibility in this brief discussion of management.

*The information describing San Francisco Bay was taken from the San Francisco Bay Conservation and Development Commission Study. Extensive use was made of the report entitled "San Francisco Bay Plan Supplement."

Therefore, we present one aerial view (Figure V.7.2) and further attempt to describe the Bay in terms of its uses and the problems facing it.

USES

San Francisco Bay is the most important harbor system on the Pacific Coast of the United States. Waterborne commerce through the Golden Gate amounted to nearly 32 million tons in 1965. A deep-water ship channel extends up the Sacramento River for 43 miles to Sacramento. Total traffic amounts to 2.2 million tons per year with 340,000 tons being in deep-draft vessels and the remainder in barges. Another deep-water channel extends to Stockton.

Supervessels, particularly for transporting petroleum, have increased the need for greater project depths.

The physical Bay is a natural resource in itself--of minerals (sand, salt, cement), of marine life (commercial and sports fishing), a waterfowl habitat frequented by lovers of the most expensive form of hunting, and a recreational boater's Mediterranean in miniature.

The mineral resources of the Bay include the salt, cement, and sand industries. The Bay area supplies almost all of the salt consumed in northern California, Oregon, Washington, northern Idaho, and western Nevada. Almost a third of the total supply is used by

FIGURE V.7.2 AERIAL PHOTO OF SAN FRANCISCO BAY



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large chlorine-caustic plants. Even the brine drawn from the salt ponds in the last stages of the solar evaporation process is considered important. It is called bittern and from it are extracted magnesium chloride and bromine as well as chemicals used in the manufacture of gypsum. The salt ponds are located in San Mateo, Santa Clara, Alameda, and Napa Counties.

Deposits of oyster shells and blue clay found in the Bay are less important economically than the salt and other chemicals. The shells are sold to chemical companies and firms manufacturing soil conditioners and poultry feed.

Sand deposits in the Bay have served as a basic source of fill for tideland areas, but have been of too-poor quality for general industrial use. Sand for industrial purposes is largely extracted from pits in ancient river beds in Alameda County. Approximately 5 million tons come from these sources each year for building and paving in the Bay area.

The Bay provides a matchless natural harbor and habitat for probably the greatest variety of fish and wildlife of any comparable body of water in California. The area's marshlands, mudflats, and permanent water areas (an important resting spot for migratory birds in the Pacific flyway) support large populations of waterfowl. At least six species of anadromous fish run into or through the Bay going

to or from spawning grounds, while 150 species permanently inhabit these waters.

Activities that are principally concerned with the use of water as a medium for movement include power-boating, sailing, water skiing, fishing from boats, scuba-diving, and riding sightseeing boats and ferry boats.

Boating registration in the Bay area counties increased from 53,000 in 1960 to 83,000 in 1965, an increase of some 57 percent. It has been reported that an inventory taken in 1965 of wet-storage facilities indicated a total 12,700 spaces available and 270 lanes of launching also existed.

San Francisco Bay is a receptacle for waste from municipal (domestic), industrial, and agricultural sources throughout its tributary area.

Three hundred and ninety-eight million gallons of treated sewage and industrial wastes are discharged daily during dry weather to the tidal waters of the Bay system from 77 municipal sewerage systems. Approximately 35 percent of these waste flows receive secondary treatment at 23 sewage treatment plants with the remaining flow receiving primary treatment at 54 sewage treatment plants. No community is discharging waste without treatment in the San Francisco Bay region. Forty-seven municipal waste discharges are now disinfecting or have facilities capable of disinfecting their waste flow which amounts to 245 million gallons per day, while 32 dischargers with a total waste

flow of 153 million gallons per day do not have disinfection facilities.

A total of 269 million gallons per day of industrial wastes is discharged into the Bay system by 47 industries. It is estimated that approximately 94 percent of this waste flow is cooling water drawn from the Bay system and circulated in closed cooling systems. Most of the industrial waste discharges are located along the shorelines of Contra Costa County and discharge their wastes to San Pablo or Suisun Bay. These discharges contribute more than 70 percent of the biochemical oxygen demand loading in these areas; however, the depletion of dissolved oxygen below 5 mg/l has not been measured immediately beyond industrial waste effluent dilution areas delineated by the Regional Board.

The number, location, and degree of treatment of both municipal and industrial waste discharges changes with the continuing implementation of recommendations in studies of sewerage needs and of master plans.

Storm water runoff not containing sewage, discharged from storm sewers, from flood control channels and from tributary streams is a factor affecting water use. Also governing water usability are the sediments from such activities as: agricultural practices, residential development, highway construction, and mining of natural resources.

The tributary streams and rivers also carry unknown quantities of nutrients, pesticides, and organic and inorganic material drained from residential, agricultural, and forested lands. The magnitude of the present water quality problem created by these factors is unknown.

SECTION 7. MAJOR PROBLEMS AND DANGERS TO THE BAY

Enjoyment of the Bay is adversely affected by:

(1) Land Fill Problems. Wildlife and shellfish resources are damaged and sometimes lost when tidelands and marshes are filled. Eighty percent of the marshland has been "reclaimed". About 20 percent of the reclaimed areas are salt ponds and are currently used by wildlife. Fifty percent of the remaining water area of the Bay is vulnerable to reclamation and fill. Current uncontrolled urban growth threatens both tidelands and marshes.

<u>Habitat</u>		<u>Amounts in 1967</u>	<u>Reclamation Losses</u>
Original Amounts (before reclamation)			
Marshlands	300 sq. miles	50 sq. miles	250 sq. miles (83 percent)
Tideflats	82 sq. miles	65 sq. miles	17 sq. miles (21 percent)

The effects have been noticeable. Wintering waterfowl population originally numbered about 2 million to 3 million. Today, wintering waterfowl populations number about 600,000 to 800,000, a loss of approximately 1.8 million waterfowl.

Prior to 1900 the annual commercial harvesting of the oyster fishery amounted to 10 to 15 million pounds. With

the advent of water pollution, today there is no oyster fishery.

Before 1935 the annual commercial harvest of soft-shell clam fishery varied from 100,000 to 300,000 pounds.

Because of the water pollution problem there is no commercial soft-shell clam industry. Recreational clam-digging is virtually nonexistent due to contamination.

The annual commercial landings of the shrimp fishery prior to 1936 were as high as 6.5 million pounds. Landings in 1965 were 10,000 pounds.

In 1830, 5,000 sea otter skins were annually taken from the Bay. Today there are no sea otters. Kelp beds were abundant in the Bay at that time. Today we know of no kelp beds.

The harbor seal were abundant until about 1890. Today there are about 90 to 150.

(2) Water Quality Damage. Historically, upstream hydraulic mining has severely altered the ecology of the Bay, through siltation.

More recently the volume of poorly treated industrial, agricultural and domestic wastes have increased to the point where fishlife has been damaged in some areas.

Annual die-offs of hundreds of striped bass continue to occur throughout the Bay during the late spring and summer. The cause of these mysterious phenomena and their relationships to other factors in the Bay remains unknown. Reports of tainted striped bass flesh have been received. The problem is being investigated by a joint committee of State and private agencies.

The ever-increasing tonnage in shipping in the Bay area has caused an increase in the number of accidental oil spills from ships.

(3) Loss of Esthetic Enjoyment. Floating debris, trash and litter from pleasure and commercial vessels, oil slicks and other waterborne wastes all contribute to the unsightliness of Bay waters.

At the same time a few of the shoreline developments are of poor quality, and are inappropriate to a waterfront location.

There has also been a failure to take advantage of the dramatic view potential from hills surrounding the Bay because of poor road layout and poorly placed buildings or plantings. (There are many notches, passes, and tunnels through the rim of hills around the Bay on which the traveler is suddenly introduced or reintroduced to views of the Bay.)

(4) Inadequate Public Access. Loss of public access to the Bay is a serious problem. Public access is now extremely inadequate and will become even more serious in the future. Of the 276 miles of San Francisco shoreline, scarcely four miles form the boundaries of waterside parks.

(5) Population and Pollution Problems. The heart of the San Francisco Bay planning problem is people and more people. The population of this area will grow but the Bay cannot.

Historically, California and the Bay area have experienced a much faster rate of population growth than the rest of the Nation, because so many people have migrated to California from elsewhere in the United States. The Association of Bay Area Governments' projections assume these migrations will gradually decline over the coming decade. The estimates assume that in about 50 years almost as many people will be leaving California every year as will be moving into the State; the U.S. Census Bureau studies have found that the rate of interstate migration is slowing down and the Bureau expects an eventual "state of equilibrium."

The population of the Bay area, the delta, and the Central Valley, whose rivers and streams feed into the

delta and Bay, is about 6 million now and will increase more than 3 1/2 times by the year 2020. The 16 million new residents will require tremendous supplies of water-- and they will produce even larger quantities of wastes.

There is as yet no detailed prediction of the expected increase in liquid wastes. The U. S. Public Health Service indicated in 1963 that the volume of effluent discharged into the Bay would increase to perhaps 1,100 million gallons per day by 1990 and to more than 1,700 million gallons daily by 2015.

(6) Agricultural Wastes. The Federal Water Pollution Control Administration has completed a study of the effects of the proposed San Joaquin Master Drain on the Bay. The study concluded that the proposed drain, which would carry agricultural wastes from the Central Valley to an outfall near Antioch, would have a significantly harmful effect on the waters of the Bay and delta, adversely affecting fishing, recreation, and esthetic values.

This harm would come primarily from nutrients the drain would deposit in the Bay; the nutrients would stimulate the growth of large quantities of algae and other aquatic plants. The FWPCA study also concluded, however, that these detrimental effects would be minimized by treatment

of waste waters; therefore, the FWPCA recommended that no discharge from the drain be permitted for at least five years, i.e., until 1972, so that pilot treatment facilities can be built and tested.

Interestingly, the FWPCA study also concluded that the drain, as presently planned, would not increase the present pesticide content of the Bay and delta, principally because most pesticides are absorbed or decomposed as they pass through the soil of farmlands, while the drain would collect sub-surface waters.

The pressures on San Francisco Bay area are very similar to those of Chesapeake Bay. Population pressures are present and these people look to the Bay as a source for water supply, transportation, recreation, and waste disposal. Dredging and filling are present to the extent that more than 80 percent of marshland, and 20 percent of the tidelands have filled with resulting losses to fish, shellfish, and wildlife. There is a need for deepening shipping channels to accommodate larger ships.

SECTION 8. PROGRESS IN CURRENT MANAGEMENT

In San Francisco, after the completion of the excellent, in-depth study report by the San Francisco Bay Conservation and Development Commission and its recommendations, followed by extensive legislative debate and passage, progress in providing the necessary management capability could be classed as excellent.

On August 7, 1969, the Governor of the State of California signed into law the McAteer-Petris Act which provided for stringent control of shoreline development in the San Francisco Bay area.

The BCDC became the permanently established agency with powers and jurisdiction enabling it to protect the Bay.

The amended McAteer-Petris Act provides for the following:

- (1) Future development of the shoreline will include a number of prime water-oriented uses such as "ports, water-related industries, airports, wildlife refuges, water-oriented recreation and public assembly, desalinization plants and powerplants...."
- (2) Saltponds and wetlands and a 100-foot strip of shoreline surrounding the Bay are to be protected.
- (3) BCDC has the power to issue or deny permits for any dredge and fill projects or any substantial change in the use of water, land, or structures within the Commission's jurisdiction.

(4) Filling will be authorized only when its benefits are greater than the detriment resulting from the loss of water areas. Fill should be limited to water-oriented uses.

(5) Fill should be authorized only when an alternative upland location cannot be found. Any water area authorized to be filled should be the minimum area necessary.

(6) The nature, extent, and location of fill should be such that it will minimize harmful effects to the Bay. Fill should be authorized when it will establish a permanent shoreline. Applicant must have valid title to property which is to be filled.

(7) In order to make the Bay more accessible to the people, the shoreline area should be improved, developed, and preserved. Private and public development of the shoreline should be encouraged.

(8) The Commission will review and prepare reports on estimated costs and method of financing proposed acquisition of private property for public use.

These definitive and incisive powers are to be exercised by a 27-member commission, nearly half of whom are to be elected officials. In addition, there are also two members appointed from the State Legislature who are to participate in the activities of the Commission.

The legislative enactment of BCDC goes a long way towards providing the necessary ingredients in the comprehensive management of San Francisco Bay.

The concept of a comprehensive ocean area plan is now also being formulated by the State of California.

Water Quality Standards for San Francisco Bay have been adopted and approved by the Secretary of the Interior.

The Governor also recently signed the most comprehensive water quality control law in the Nation. The California Water Quality Improvement Act of 1969, which goes into effect next January, authorizes, among other things, a fine of up to \$6,000 a day for failure to comply with the State's water discharge standards.

Prior to the creation of the San Francisco Bay Conservation and Development Commission and its subsequent legislative enactment, there was no coordinated regional control of dredge and fill except for the permit-granting authority of the U.S. Army Corps of Engineers concerning navigation. No State permit was required except for very specialized reasons, such as, removal of minerals from State lands.

Regional planning has been present, but not very effective since there has been no regional agency given jurisdiction over the entire Bay prior to the San Francisco Bay Conservation and

Development Commission. Other regional developments include: the "Bay Area Transportation Study Commission," which completed a regional transportation plan with recommendations for implementation; the "Association of Bay Area Government" which began in 1961 performing advisory regional planning; and the "Joint Committee on Bay Area Regional Organization," a committee of the State legislature, after a 16-month study, proposed a limited-function nine-county regional government to encompass the State-designated water basin boundaries.

Research and study to support improved management activities is proceeding as is shown from the following activities:

- (1) The State Legislature, in 1965, authorized a comprehensive study and development of a water quality management program for the Bay area. The report has been recently published.
- (2) The Bureau of Sports Fisheries and Wildlife is examining the effects of dredging on bottom life in the Bay.
- (3) The Geological Survey has authorized programs to collect geologic and hydrologic data, and to investigate the Bay sediments.
- (4) The Federal Water Pollution Control Administration completed a study on the effects of the proposed San Joaquin Master Drain on the Bay in December 1966.

(5) The San Francisco Bay-Delta Water Quality Control Program financed partially with an FWPCA grant is involved in a comprehensive water quality management study concerning the development of a master plan for construction of a collection, treatment, reclamation and disposal system to be staged over the 50-year period, 1970 to 2020.

(6) The Secretary of the Interior has established both Field and Headquarters Task Forces to cooperate with the State of California and to improve coordination of Interior's interests in the Bay.

(7) The Corps of Engineers has undertaken a coordinated comprehensive survey of the entire Bay complex with other Federal agencies concerning navigation, flood control, transportation, water supply, land reclamation, recreation, national defense and allied subjects. The survey is scheduled for completion in 1972; it is operating a scale hydraulic model of the Bay at Sausalito and is extending the model to include the Sacramento-San Joaquin Delta; and the Corps of Engineers has proposed a multimillion dollar, multiagency study of the development of San Francisco Bay as a port to handle super-sized vessels.

SECTION 9. EVALUATION OF THE SAN FRANCISCO BAY

At the beginning of Chapter 7, Section 1, mention was made of the several necessary elements for a comprehensive program of management. The evaluation of management in San Francisco Bay which follows is made in reference to those seven elements.

POLICY AND OBJECTIVES

Regarding mutually agreed upon policy and objectives, very little, if any, existed on the State level, prior to the enactment of BCDC. In fact, the State of California, in essence, had surrendered control; there was no area-wide political authority guiding the destiny of San Francisco Bay. Such policy and objectives now exist for the Bay. There is additional need for a national policy and objectives.

LEGISLATIVE AUTHORIZATION

On the State level the recent legislative passage of the BCDC bill and its signing by the Governor has produced the necessary first step in this direction by establishing a permanent agency with powers and jurisdiction to care for, protect, and properly manage the nine-county area of the Bay. At the same time, on the Federal level there is also a need for a much stronger program of technical information and assistance to the States, as well as objectives for more effective management.

DEVELOPMENT OF BASIC KNOWLEDGE

The BCDC Study and the report published as a result of that study indicate quite satisfactorily the existence of the best available information. Nevertheless, new information and knowledge are constantly being produced and BCDC, the responsible agency for coordinating activities of the Bay, is authorized under the enacting legislation to continually review subject areas under its jurisdiction.

PLANNING AND IMPLEMENTATION

In the past, planning has not been one of the hallmarks in the administration of the Bay. Consider the size of the Bay in 1850 and what it is today. Where 300 square miles of marshland once remained in the Bay, 250 square miles had been "reclaimed" by 1967. The filling in of the tidal and submerged lands have dried up 17 square miles that once were Bay. Passage of the BCDC, hopefully, will put a stop to these activities.

Responsible Federal officials have indicated a satisfaction with what BCDC has accomplished, and are now watching to see if it will have the power to protect the national as well as local interest, and thereby serve as a prototype for State and regional action elsewhere in the Nation.

ACTIVE ADMINISTRATION - REGULATION, CONTROL, AND COORDINATION

In the past there were management problems which contributed to interference and damage to the beneficial uses of the Bay area. There was,

for example, a lack of coordinated control of land and water uses. Administration of Bay lands and waters was accomplished by Federal and State agencies, nine counties and 91 city governments. Local entities appeared unwilling to sacrifice local autonomy to some overall coordinated controlling power. There was only limited control over dredging, filling, and alteration, and there was no coordinated regional zoning or other control over the use of water and adjacent land. There was a lack of coordinated planning. No true comprehensive development plan coupled with the authority for implementation existed. The Association of Bay Area Governments presented such a plan but, due to conflicting local interests, its implementation has become bogged down indefinitely while uncontrolled development reduced the remaining natural values of the Bay. Finally, there was also a lack of legal definitions of land ownership. Boundary lines between State and private lands are confused and complex. Clearer definition of existing State lands will be needed along with the acquisition of additional shallow water area.

FINANCIAL RESOURCES

There has been a steady growth in the number of personnel and the amount of monies devoted to estuarine management. Nevertheless, considerable augmentation will be needed if comprehensive plans are to be made and implemented as provided by the BCDC legislation. For example, funds will be necessary (1) to finance development of the

Bay and shoreline to their highest potential, and (2) to pay the operating costs of the agency designated to carry out the Bay plan. If it were desired to compensate private owners of the Bay lands that cannot be filled, then additional funds would be required for this purpose.

PUBLIC AWARENESS AND ACCEPTANCE

The timely rescue of San Francisco Bay represents a demonstration of what concerned Americans can still do to protect their environment, and even to save what is left of grace in their urban areas. This untiring citizen effort, aided by a steadily swelling number of organizations, and local government led first in 1965 to the establishment of a temporary BCDS with limited power and, secondly, to its permanent establishment with strong powers and effective authority.

Almost as refreshing as the outcome itself is the fact that the movement to rescue San Francisco Bay resulted in a plan which devoted a large part of its future effects to the social values of the estuaries--those which unfortunately have all too long in the past been neglected.

The public continues to participate in the membership of the 27-man San Francisco Bay Conservation and Development Commission. Seven representatives of these 27 members are appointed from the general

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public, another 13 of the 27 are elected officials and the remaining 7 are representatives of State and Federal agencies.

SECTION 10. SUMMARY AND CONCLUSIONS

Summarizing from the evaluations of management in the Chesapeake and San Francisco Bays, it is apparent that the immense value and the need for action both to conserve and to develop them has been recognized both by government and by the people. But even more so has been the recognition by the people and private organizations who brought their governments to the point of action.

The need for a comprehensive plan of management remains evident in the Chesapeake. In San Francisco Bay such a plan is in force. However, in terms of administration and regulation, neither California, Maryland, nor Virginia have instituted effective State control of dredge, fill, and alteration. Zoning or the control of land use adjacent to the estuarine waters is exercised at the level of local government and certainly has not yet been generally effective in the preservation of estuarine areas. The Bay Conservation and Development Commission plan for San Francisco Bay has been an exception to this for the past three years and hopefully will continue to exercise appropriate controls.

At the Federal level there is considerable evidence to indicate that a national policy with accompanying objectives and guidelines would provide helpful impetus to State programs even though many are proceeding without it. The augmentation and coordination of Federal programs in the estuarine zone is a very current need. Although the development of the necessary basic knowledge by research and

study has made much progress, there remains much more to be done if comprehensive management plans are to receive the support they need.

San Francisco Bay suffered rather severe degradation before the "Save the Bay" organizations by their efforts brought the Bay Conservation and Development Commission into being. As a result, there is now a comprehensive plan for the preservation, use, and development of the Bay. The Chesapeake Bay, on the other hand, is at present little damaged except in local areas generally near the population centers. Nevertheless, it faces growing problems of population pressures and industrial development with the problems involved in being an interstate estuary. This means, of course, that preparing and carrying out a comprehensive plan of management must sooner or later be a coordinated effort on the parts of both the States of Maryland and Virginia.

As can be seen, these two case studies, as brief as they are, again bring out the need for and the importance of a comprehensive plan at the State level, a national policy and objectives, augmentation of programs directed to the estuarine and coastal zone, and the establishment and implementation of better and stronger regulatory controls.

These conclusions reinforce the discussion and findings in the study of the roles of local, State, interstate, and Federal programs in developing a comprehensive national estuarine program.

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Chapter 8

SUMMARY AND CONCLUSIONS

GENERAL SUMMARY

The Nation's estuarine and coastal resources today are seriously impaired and, in some cases, have suffered impairment which is irreversible. Fundamentally, this loss is the result of unwillingness or inability of the governments sharing responsibility and authority for their management to do the things necessary to protect these resources for all beneficial uses today and to conserve or preserve their maximum future usefulness.

The reasons for this unwillingness or inability are various and highly complex. Most basic, perhaps, are four reasons:

- (1) Shortsighted, imbalanced, or otherwise inadequate public policies governing the use of these resources up to now necessarily have reflected the dominant values of the American people. These traditionally have given a high priority to economic growth and technological development without adequately considering the adverse effects upon the estuarine and coastal environment.
- (2) Another reason, undoubtedly, is ignorance concerning the sometimes fragile and always interdependent nature of the complex of resources found in the estuarine and coastal zone.
- (3) Fragmentation and conflicts among governmental programs charged with the management of these resources have

handicapped sound management. Closely related are, on the one hand, the limited use of plans which in fact coordinate the fragmented activities of the numerous agencies and governments involved in the management of these resources; and, on the other hand, the limited effectiveness of institutional arrangements now in being which were intended to overcome this fragmentation through inter-agency and/or intergovernmental review and consultation or through joint or cooperative action. Also a contributing factor is the absence in these programs of policies and organization focusing specifically on the resources of the estuarine and coastal zone.

(4) Although governments in the more recent period have moved to establish essential programs to conserve or preserve these resources, inadequate funding has prevented these programs from adequately accomplishing their mission.

GENERAL CONCLUSIONS

The National Estuarine Management Program must achieve, first, the determination, in and out of government, to manage the use of these resources so as to protect them for as many beneficial uses as possible both now and in the future; and, second, the capability at all levels of government to do so.

More specifically, this means that the National Estuarine Management Program should be directed toward five broad objectives:

- (1) The first is development and adoption of plans which will result in balanced development, conservation, and preservation of estuarine and coastal zone resources. Developed for specific estuarine and coastal areas, these plans should control the use of the resources of these areas for as many beneficial purposes as possible. Where some uses are precluded, the plan should allow that mix of uses which, based on both short and long-range considerations, is judged to be the most beneficial. Once adopted, it should control the activities of all involved in managing the estuary or coastal area included in the plan.
- (2) The second objective is the strengthening of governmental regulatory programs and other activities directed toward implementing and obtaining compliance with the use and management plan adopted for a specific estuary or coastal area. Basically, this requires improved management authority and organization.
- (3) A third objective is the initiation of studies, research, and inventories in the estuarine and coastal zone to greatly increase knowledge about these resources and understanding of their interrelationships and behavior.

(4) The fourth objective is the adequate funding of all of the essential governmental programs.

(5) The fifth objective is the development of the public support on which achievement of the other objectives ultimately is dependent.

A second conclusion is that the sharing of responsibility and authority which marks the present approach to the management of the estuarine and coastal zone also must become an essential feature of the National Estuarine Management Program. In turn, this means that the national program should create a Federal-State-local relationship which makes maximum use of the particular and sometimes unique capabilities which each level of government can bring to bear in a coordinated and comprehensive effort to wisely manage the resources of the estuarine and coastal zone. The outlines of such a relationship are defined in the sections which follow.

ROLE OF STATE GOVERNMENTS

SUMMARY

The States today exercise the primary responsibility for the management of the resources of the estuarine and coastal zone. It is the States which are primarily responsible for the prevention and control of pollution in the estuaries and coastal waters. They hold title to the submerged and tidal lands and are thus in a position to control their use and modification. Although most States

have delegated authority to control land use to their local governmental units, they legally retain the ultimate authority to control the use of shorelines and related uplands in the estuarine and coastal zone and thus to decide whether these lands are to be used for industry and commerce, parks and recreation, fish and wildlife habitat, residential housing, or other purposes. They determine the forms and functions of local government generally in managing water and related land resources, and the same holds true for the interstate instrumentalities which, at their option, they may create for management purposes. Fisheries and other living estuarine resources are under their direct control. Each State presides over the legal system which governs private relations and resolves the conflicting rights, interests, and privileges of its citizens in the development and use of estuarine and coastal resources. And, finally, even in those areas in which the Federal Government exercises exclusive or primary authority, the nature of this Country's political process gives State groups and officials substantial power to influence the objectives and the exercise of Federal policies.

CONCLUSIONS

The powers which the States possess clearly are strategic ones in achieving balanced development, conservation, and preservation of the resources of the estuarine and coastal zone. The National Estuarine Management Program accordingly should continue to vest

the primary responsibility for the management of these resources in the States. As this analysis has shown, the States have ample constitutional authority and, in all instances, they already are administering on-going programs in the estuarine and coastal zone on which the national program can be built. Through their authority over local governments, the States also are able to delegate to the local level that authority which can best be performed locally. As a corollary, they also can oversee the exercise of local authority so as to insure that the larger State and national interests in the development and use of locally situated resources prevail over more limited or erroneous local perceptions of the public's interest in these resources. They also are close to the scene and thus better able than the Federal Government to respond to the unique needs and opportunities of each estuary and coastal area. At the same time, however, they are in a better position than local governments to resist pressures for unwise development.

In order that the States will effectively discharge this primary responsibility, the tactics of the National Estuarine Management Program should seek to have each State develop, either directly or through its local subdivisions, the plan (or plans) which will control future use of the State's estuarine and coastal zone; and, further, take the steps necessary to insure compliance with these plans by its own agencies and its local governmental units. Two steps are especially essential in this regard. One is the better

establishment of State-level organization, not dominated by any particular interest, with the capability of administering or coordinating State-level management activities in the estuarine and coastal zone. The other is the establishment by the State of more effective supervision and control over the actions of local governments in that zone. In addition, the State organization created or designated for this purpose should have the capacity to integrate Federal service programs into the State's management activities in its estuarine and coastal areas and, even more important, to play a strong advisory role with respect to Federal programs and projects more directly managing the resources of these areas.

ROLE OF LOCAL GOVERNMENTS

SUMMARY

The States typically have delegated or assigned authority to their local subdivisions to carry out a broad range of functions which directly or indirectly may have important effects on estuarine and coastal resources. Among these significant activities are: (1) planning and zoning of land use; (2) provision, either directly or otherwise, of water supply, waste collection and treatment, and other utilities; (3) construction of port facilities, roads, and bridges; (4) provision of beaches, parks, marinas, fishing piers, and other recreational facilities; (5) regulation of the use of septic tanks in the zone and the administration of pest control and other public health protection programs; (6) regulation of fills and

the administration of drainage projects; (7) promotion of industrial or other economic development; (8) maintenance of property and other essential records; and (9) administration of local courts to establish justice and equity in interpersonal relations.

Although the primary responsibility for the management of the resources of the estuarine and coastal zone now rests with the States, the above listing clearly demonstrates that local governments today in fact are making many of the most crucially important decisions which actually govern the management and use of these resources. Located "on scene" they are themselves major users of the zone's resources. Moreover, they are highly responsive to public and private interests in the nongovernmental sector which also are directly engaged in developing and using these resources to satisfy human wants and needs. In both respects, therefore, local governments today occupy the most crucial spot in the management of estuarine and coastal resources, because of the consequences, for the good or ill of the estuarine or coastal resources concerned, of the States' local assignment of control over local activities.

Local governments naturally desire to promote the economic growth of the local area and to improve the community's property-tax base which traditionally has financed most of their activities. However, each local unit usually is too small to envision or respond effectively to the needs of an entire estuary or coastal area.

Frequently, they also have lacked funds, and therefore the staff,

to maintain the expertise which is capable of fully understanding all of the ramifications of local actions upon the larger estuarine and coastal zone. The result is that all too often local governments have succumbed to strong economic and political pressure to proceed with poorly planned or unwise development of estuarine and coastal resources, or to permit such development by those in the nongovernmental sector. In succumbing to these pressures, local governments unfortunately have contributed much to the impairment of the Nation's estuarine and coastal resources.

CONCLUSIONS

Although the record of local governments in managing estuarine and coastal zone resources on the whole is subject to criticism, the Nation's effort to improve management of these resources should retain a significant role for local governments in the new national program. The reasons include the already-mentioned "on scene" relationship and its effect on the ability of local government to sense and respond to unique conditions, and also its ability to mobilize the support and cooperation of local civic and private interests. But they also include the value which the American people attach to self-government, to decentralization of governmental authority and responsibility, and to local experimentation and innovation in developing new national programs.

In brief, therefore, the role of local government in the National

Estuarine Management Program should be to carry out, with State and Federal support and assistance, and under the State's supervision, the estuarine and coastal management functions delegated or assigned to it by each State. This conclusion recognizes that the resulting local role may vary from State to State. Thus, in some States, a review of the present combined State-local management capability and effectiveness may conclude that local governments should continue to exercise substantially the same functions as they now do, but also recommend improved supervision by the State. In others, a review may recommend that the State government assume and itself directly exercise important components of estuarine and coastal management authority and responsibility now delegated to its local governments.

What is essential in most States, if not all, is a better State-local division of authority and relationship which will enable these two levels of government together more effectively to discharge the State's primary responsibility for achieving balanced development, conservation, and preservation of estuarine and coastal resources.

ROLE OF THE FEDERAL GOVERNMENT

SUMMARY

Under the Constitution, the Federal Government possesses the primary authority to conduct foreign affairs and to maintain the national security, a consideration obviously of major importance in managing

the estuarine and coastal zone. Moreover, as interrelated parts of a single governmental system, the Federal, State, and local governments in this country share in the exercise of most domestic functions. It is not surprising, therefore, that the Nation's approach to the management of its estuarine and coastal resources also has been characterized by important involvement by the Federal Government. This involvement has reflected not only the primary authority of the Federal Government in the areas mentioned and its paramount authority over the use of estuarine and coastal waters for navigation and commerce. It also reflects numerous decisions by the Congress, supported by the Supreme Court, that the Federal Government too has a major responsibility to promote and protect a broad variety of other beneficial uses of the resources of this zone.

The resulting activities of the Federal Government today in participating in the management of these resources are extensive and fall into five broad categories.

First, the Federal Government regulates, either directly or in support of regulatory activities by the States: (1) the use of estuarine and coastal waters for the disposal of various wastes; (2) the placing of structures over and in navigable waters; (3) the designation of navigable waters as danger zones and for certain uses such as fishing grounds; (4) the establishment of harbor lines; and (5) the use of estuarine and coastal waters for the generation of electric power.

Second, Federal agencies directly acquire and administer estuarine and coastal sites for a variety of uses, including habitat to protect fish and wildlife resources; seashore areas, parks, or other recreational facilities; military installations; saline water conversion; and other purposes.

Third, the Federal Government makes grants to the States, local governments, and others for activities which span the entire range of estuarine and coastal zone management functions and purposes.

Fourth, most Federal agencies perform functions to assist and support the use and management of estuarine and coastal resources generally, and State and local programs in particular. Services include: (1) preparation of comprehensive or functional plans for the use and management of water and related natural resources; (2) special studies, inventories, research, and data collection activities; (3) information dissemination and other education programs; (4) technical aid and assistance in a broad range of areas; and (5) provision of navigation, flood control, beach protection, and other public works, facilities or services in the estuarine and coastal zone.

Fifth, by enacting statutes such as the Fish and Wildlife Coordination Act, the Water Resources Planning Act, and other statutes, and by consenting to interstate compacts, the Congress has provided, or agreed to, procedures and organization designed to improve the coordination of the programs of different agencies and

governments in the estuarine and coastal zone.

CONCLUSIONS

The National Estuarine Management Program cannot abrogate the Federal interests in the estuarine and coastal zone nor the missions which the Congress, pursuant to those interests, has assigned to various Federal agencies. Instead, it is imperative that the program include the Federal Government as a strong and active participant. This means Federal action on three fronts.

(1) The first is the full and effective mobilization and use by all Federal agencies of estuarine and coastal zone management authority and responsibility which they now possess by assignment from the Congress. This will, in many instances, also require increased funding of these programs by the Congress. It also may require action by the Executive, both at the Presidential and departmental levels, to improve utilization of authority now available.

Although all present Federal activities applicable to estuarine and coastal zone management purposes -- ranging from service to regulatory functions -- clearly can and must participate on this front, a number of actions are especially critical and essential. These include:

(a) Increased funding of Federal construction grants

for waste treatment facilities to facilitate prompt implementation of established water quality standards in estuaries and coastal waters. Funding of all of the waste treatment facilities needed at Federal installations to eliminate their contribution to pollution in these waters also is urgent.

(b) Maximum utilization of other existing Federal grant programs which can be applied to estuarine and coastal zone management purposes. Examples are programs under (1) Section 701 of the Housing Act of 1954, Title III of the Water Resources Planning Act, and Section 3(c) of the Water Pollution Control Act, all providing grants for comprehensive planning; (2) the Land and Water Conservation Fund Act, which provides grants for Federal, State, and local acquisition and development of estuarine and coastal sites for conservation and recreation purposes; (3) Section 6 of the Water Pollution Control Act, the Water Resources Research Act, and the National Sea-Grant College and Program Act of 1966, all authorizing grants which can be utilized for research and study in estuarine and coastal areas; and (4) Section 7 of the Water Pollution Control Act, providing grants for the administration of State and interstate water pollution control programs.

(c) Full use of direct Federal authority for functional or comprehensive planning to prepare, in cooperation with the States and others, use and management plans for specific estuaries and coastal areas. Completion by the Corps of Engineers of the comprehensive study of Chesapeake Bay, including the construction of the authorized hydraulic model of this estuary, is particularly important. Also urgent is greater attention in the present framework studies being conducted under the aegis of the Water Resources Council and other Federal water resource planning programs in rivers tributary to estuaries and coastal waters to the impact of upstream developments upon downstream estuarine and coastal resources.

(d) Completion and maintenance by the Department of the Interior of the broad national inventory of estuaries and their resources initiated by the National Estuarine Pollution Study and also the inventory directed by the National Estuarine Protection Act (Public Law 90-454).

(e) Completion of presently authorized studies bearing on the use and management of estuarine resources, including the study by the Department of the Interior under the National Estuarine Protection Act of the feasibility and desirability of establishing a

nationwide system of estuarine areas; and the Corps of Engineers' national shoreline erosion survey authorized by Congress in Public Law 90-483.

(2) On the second front of required Federal action, the Congress should enact legislation establishing the National Estuarine Management Program. Purposes of this legislation should be three:

- (a) To establish the basic policies and objectives which are to guide that program at all levels of government.
- (b) To provide the Federal incentives which will act as an impetus for needed action by the States under that program.
- (c) To authorize the new actions which that program should require from Federal administrative agencies.

The legislation's statement of policies and objectives should stress the national interest in the balanced multi-purpose development, conservation and preservation of estuarine and coastal resources over both the short and long range. In setting this as the objective, it also should emphasize the importance of giving priority consideration to non-renewable resources and to maintaining those resources and uses which are estuarine dependent. While affirming the States' primary management

responsibility, it also should make clear the Federal Government's right and obligation in two respects. These are, first, to directly manage the use of estuarine and coastal zone resources where vital Federal interests are involved. The second is to provide continuing guidance to the States in their important management decisions. Such guidance includes not only advice and recommendations but also the delineation of improvements which the States are expected to make as a condition of Federal financial aid and support.

To create the incentives which will provide the impetus for needed State action, the new legislation should authorize a new program of grants-in-aid to be used for estuarine and coastal zone management specifically. Particular purposes of such assistance should include the establishment of organization at the State level for estuarine and coastal zone management, the administration of that organization during its first years of operation, the development of comprehensive plans to govern the use of specific estuarine and coastal resources, and research and training programs in estuarine and coastal zone management.

(3) On the third front of Federal action, the President should issue an appropriate Executive Order or proclamation

calling upon Federal agencies, the States, and others to make the maximum possible effort under existing law to implement the objectives of the proposed national policy in the interim before the National Estuarine Management Program can be activated.

ROLE OF PUBLIC AND PRIVATE INTERESTS

Achievement of balanced development, conservation, and preservation of the resources of the estuarine and coastal zone for multiple purposes will become a reality only if the public and private interests in the nongovernmental sector want and demand it. This means that these interests now must actively seek the establishment of the National Estuarine Management Program and, thereafter, give continuing attention and support to its administration at all levels of government. It means too that these interests must themselves actively participate in the administration of that program by taking part in the preparation of use and management plans for specific estuaries and coastal areas and through research and education, experimentation with new management concepts, their own programs to acquire and administer important sites within the zone to protect them from undesirable development, and continuing evaluation and criticism of governmental programs. Compliance with adopted plans in the activities which these interests conduct on their own in the estuarine and coastal zone also is absolutely essential.

Conclusions presented in this chapter are developed in greater detail in Part III, Recommendations - The Proposed Program, of the Report of the National Estuarine Pollution Study.

Chapter 9

SUGGESTED GUIDELINES FOR A STATE MANAGEMENT STATUTE

Numerous representatives of the Coastal States have expressed, through the public meetings, through State profile presentations, and through direct correspondence with the National Estuarine Pollution Study staff a need for suggestions from the Federal Government as to how the States can develop improved or strengthened provisions for the use control of their estuarine resources. Details on these suggestions are included in the preceding Chapters 2 and 5.

Consequently, the National Estuarine Pollution Study made an initial attempt to develop such guidelines through a contract awarded to the University of Maryland School of Law. The result of this contract was the development of a Model Statute for Chesapeake Bay Basin Management based upon the existing condition in the adjacent Chesapeake Bay. This specific geographic area was selected as the basis for the development of the guidelines because of its wide range of governmental relationships, characteristics, benefits, potentials, and use conflicts which exist not only in the Basin area but also in other major estuarine areas. Therefore, this suggested Statute, presented in the following pages of this chapter, is considered to meet many of these problems and to include many of the basic principles which would be applicable to other estuarine areas of the United States; also it is included because it is an

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excellent piece of work. It is of course not presented as this Study's recommendation for any action by the State of Maryland, or any other coastal State.

**A MODEL STATUTE FOR BAY BASIN MANAGEMENT:
ADAPTED FOR ADOPTION IN MARYLAND**

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General Comments

The starting point in drafting "model" legislation is a question—what is wrong with existing laws and legal institutions? The most frequent response when this question is asked with reference to Chesapeake Bay is—"fragmentation of authority." It is true that there is no shortage of Bay government. The Federal Government, the governments of Maryland and Virginia, the governments of their respective counties and cities, and an interstate compact commission, all have spheres of governmental authority.

But this is not the crux of the problem. The Federal Government has demonstrated its willingness to cooperate with, and to defer to, effective State action. The Federal water quality program affords a good illustration. The legislatures of Maryland and Virginia have zealously avoided the delegation of significant powers over the Bay to counties or cities. Although the Bay is divided between Maryland and Virginia, both have a significantly broad territorial expanse to effectively manage their respective portions. The only extant compact commission is limited in power to the Potomac fishery.

Hence the problems which exist are to be found primarily within Maryland and Virginia State government. Existing State legal institutions suffer from two major inadequacies. First, the State legislatures, clinging vestigially to the nineteenth century, have attempted to administer the Bay themselves. Rather than delegating broad managerial power to the executive branch, they have responded to narrow problems with narrow legislation. These responses rapidly become out-of-date but linger on as law. In short, the legislatures have refused to give administrators the "range of choice" necessary for effective management.

Second, these powers which have been delegated by the legislatures have been scattered throughout the States' administrative apparatus. Various State agencies have duplicating, overlapping and sometimes inconsistent powers, but in neither Maryland nor Virginia is there a single agency with the requisite authority to plan and coordinate the administration of the Bay and its resources.

In recent years the most popular model for meeting the problems of river basin management has been the Federal-interstate compact. The success of the Delaware River Basin Commission has led to the negotiation and proposal of similar compacts for the Potomac and Susquehanna Rivers. Such a management model has certain advantages for the Chesapeake Bay. A compact between Maryland, Virginia, the United States (and perhaps Delaware) could be given territorial jurisdiction over the whole Bay. Theoretically, at least, the State legislatures could delegate broad powers to the compact commission which could exercise them in coordinated, autonomous fashion (free from State legislative interference) for the compact's duration.

But the compact model also has disadvantages. It adds yet another tier to the existing surfeit of Bay governments. It would be difficult to integrate such a compact with the already negotiated and proposed Potomac River Basin Compact which has powers over the estuarine portions of the Potomac. Finally, it would be difficult to negotiate a compact which gives adequate powers to the governing commission and still would be acceptable to both Virginia and Maryland. Although Maryland and Virginia have a common interest in various aspects of Bay management they also have disparate and competitive interests in preserving the Bay resources within their respective boundaries exclusively for themselves and their citizens. At best, such a compact would take years to negotiate; at worst, it would be emasculated through the retention of powers by the States.

Because of the disadvantages of the compact format, it was decided to reform State government rather than supplant it. The legislation which follows provides such a reform, adapted for adoption in Maryland. Basically it is a legislative delegation of broad planning, regulatory, administrative and operational powers to a single state agency—The Chesapeake Bay Basin Department. The Department is given territorial jurisdiction over all waters of the State. This jurisdiction was decided upon by starting with Bay waters and moving upstream into the fresh water tributaries of the basin with the realization that fresh water input so intimately affects estuarine waters that the two cannot be rationally separated. Also involved was the perception that—since almost all Maryland waters are in the basin except for some waters on the eastern shore which drain into the bays behind the Atlantic barrier beaches and which present similar management problems—the Department might as well have authority over all State waters. Hence the title of the Department is a misnomer, chosen on the theory that the dog should wag the tail.

The territorial jurisdiction of the Department would, of course, be curtailed upon the adoption of the Susquehanna and Potomac River Basin Compacts. Assuming the adoption of these compacts, their respective commissions would have primary power within their jurisdictional bounds but to the extent they permit State regulation and activity the Department would be the Maryland operative.

The Chesapeake Bay Basin Department is designed to replace two existing State agencies—the Department of Water Resources and the Department of Chesapeake Bay Affairs. It is also designed to take from the State Health Department the power to regulate discharges of human and municipal wastes. Its primary role is as a coordinator, planner and regulator. It is charged with the duty of developing a plan for the utilization and conservation of the waters of the State and a complementary plan for utilization and conservation of Chesapeake Bay resources. It is given regulatory powers necessary to assure implementation of these plans. In addition when a need appears for Statewide development and management (for example, a State run waste acceptance system) it may own and administer facilities.

Specific Comments

ARTICLE 1

CHESAPEAKE BAY BASIN DEPARTMENT CREATED

This article defines the terms used throughout the act and lays the organizational groundwork for the new Chesapeake Bay Basin Department. This Department replaces the Department of Water Resources and the Department of Chesapeake Bay Affairs under the umbrella of the Department of Natural Resources. The Secretary of Natural Resources has powers under other sections of the Maryland Code to coordinate the activities of the Department with the activities of other related resource agencies such as the Department of Forests and Parks and Department of Game and Inland Fish.

The Director of the Department is appointed by and serves at the pleasure of the Governor. Accordingly the Director will be responsive to the Governor (or his intermediary, the Secretary of Natural Resources) and the Governor is responsible for decisions of the Department. No commissions are established which interfere with this well defined line of responsibility and authority.

Section 1.204 which provides that all moneys received by the Department shall be paid into the general fund, in essence abolishes several special funds which now exist (e.g., Fisheries Research and Development Fund, Waterways Improvement Fund). It is felt that since this act represents a broad delegation of authority to the Department, the Department should be required to clear all expenditures through the ordinary budget process.

Section 1.302 articulates the relationship between the Department and the Federal Government or interstate compact commissions. Powers of these paramount bodies take precedence.

ARTICLE 2

WATERS OF THE STATE

This article charges the Department with the obligation to adopt a plan for utilization of State waters and gives the Department the powers necessary to implement the plan.

Section 2.201 gives the Department authority to promulgate and enforce quality standards for waters of the State. Section 2.202 supplements this basic power by authorizing the Department to impose other controls such as permits establishing assimilative capacity quotas or effluent charges.

Section 2.204 is designed to foreclose the possibility of collateral attack on the decisions of the Department such as happened in Stanton v. Trustees, 233 A.2d 718 (Me. 1967) where a downstream riparian secured an injunction against an upstream discharger, even though the discharger had secured a permit from the State water quality commission.

Section 2.302 carries over the appropriations permit system for the use of water which has existed in Maryland since 1934. The cross reference to Section 3.203 adds a new wrinkle, by making clear that the State, through the Director, can require payment for the use of tidal waters. This affords a useful managerial tool in limiting the placement of thermal loads on the Bay. Certainly the use of Bay waters as a coolant becomes less attractive to a commercial user if he may be charged the fair market value of such use (one measure of which would be the cost of an alternative cooling system).

Section 2.302(c) functions as a "grandfather's clause." Under Maryland law there is some possibility that pre-1934 users of fresh water and pre-1966 users of tidal waters have some vested rights in such waters. See Md. Ann. Code, Art. 96A, Secs. 2, 11 as amended 1968. These rights have never been legally tested. This subsection recognizes that such rights may exist but places the burden of going forward on the person asserting them.

Sections 2.401 through 2.403 give the Department broad discretion to regulate the operation of boats. The Department of Chesapeake Bay Affairs presently has similar (although more circumscribed) powers under Section 1-11 of Article 14B of the Maryland Code. Section 2.404, however, transfers powers relating to the licensing of boats, presently exercised by Chesapeake Bay Affairs, to the Department of Motor Vehicles.

ARTICLE 3

THE TIDAL REGION

This Article lays the foundation for a series of special regulations over Chesapeake Bay and the bays behind Maryland's barrier beach on the Atlantic Coast.

Section 3.101 directs the Department to prepare a comprehensive plan for Bay development. The sort of plan envisioned is the San Francisco Bay Plan already developed in California.

Section 3.201 restates the State's common law ownership of tidal waters and submerged tidal lands and Section 3.202 specifies the rights of riparian land owners therein. Section 3.202 is designed to replace Sections 45 through 48 of Article 54 of the Maryland Code. It gives to the riparian essentially the same rights that the Maryland Attorney General says he has under existing law. See 50 Op. Att'y. General 452 (1965). Whether in fact, Section 3.202 is a constriction of riparian rights depends on whether the Attorney General's narrow reading of existing law is correct.

Section 3.203 provides a procedure through which the Director can transfer the State's interest in tidal waters and submerged tidal lands. Since the Director is the Governor's man the decision is the Governor's. It may be used to sell water (for use as a coolant), sand, gravel, minerals, oil, gas, etc., or land itself as a site for filling. It represents a consolidation of a variety of procedures under existing law. It should be noted that the procedure is hedged with significant safeguards. Before a person can acquire any interest, he must first acquire a permit under the regulatory procedures in either Section 2.302 or 4.302. These permit procedures give optimum protection to both public and private interests. The special notice procedure within 3.203 holds open to public scrutiny the Director's (or Governor's) decision of the price to be charged.

Sections 3.301 through 3.303 provide a new and flexible procedure through which the Department can control development of Bay shoreline. For example, it might use the power in Section 3.301 to protect non-tidal wetlands or to reserve certain shorelines for priority uses such as water-related industry or water-related recreation. Section 3.302 provides a technique through which local governments can preserve their primary land use control jurisdiction by meeting Department standards. Under Section 3.303 the Department is delegated broad powers to promulgate land use control regulations which may take the form of zoning, subdivision controls or permit procedures.

Sections 3.401 through 3.404 make a significant change in existing law. They transfer management of the Bay's fishery from statute to regulation. This will give the Department the range of choice necessary for efficient and rational management. Section 3.403 makes possible a dramatic change in oyster management. It permits the Department to shift from a public to private oyster fishery, in whole or part. The Department is given broad enough discretion so that it can negotiate mutually advantageous trade-offs with its counterpart in Virginia.

ARTICLE 4

PROJECTS AND FACILITIES

This Article provides for the regulation, management and operation of projects and facilities affecting the waters of the State and the resources of the tidal region.

Section 4.201 delegates to the Department police power authority to regulate existing projects and facilities and Section 4.202 adds special enforcement powers.

Sections 4.301 through 4.303 establish prior approval procedures for all projects affecting State waters and the tidal region. Section 4.301 regulates private projects on privately owned land. Accordingly the Department's approval authority is limited to its police powers. Section 4.302 regulates private projects on what is presumptively publicly owned land or water. Accordingly the Department is given greater discretion in the determination of whether to approve such projects. Persons receiving a permit are required to comply with the procedure outlined in Section 3.203. This provides a mechanism for assuring that the State will receive a fair return for property rights it relinquishes. Section 4.302(c) provides a procedure whereby a person who can rebut the presumption of State ownership (e.g., the owner of a valid and extant patent to submerged tidal land) can vindicate his rights if the Department refuses to recognize them.

Section 4.303 authorizes the Department to regulate projects of other governmental agencies. When dealing with other State or local agencies the powers are plenary—the Department is the supervisor of State waters and the tidal region. When dealing with the U.S. Government or compact commissions, in the exercise of their valid powers, the Department has only the power of persuasion.

Sections 4.401 through 4.403 define the Department's role as an operative and financier. It is empowered to buy, build, manage and operate necessary projects and facilities (e.g., waste collection systems, waterways improvements, shore erosion control structures, recreation areas, etc.). It may also contribute towards the financing of such projects and facilities by other governmental agencies or persons but may only contribute amounts to persons that it can justify on a cost-benefit basis.

ARTICLE 5

GENERAL PROVISIONS

Sections 5.101 through 5.106 outline the internal working procedures of the Department. Sections 5.102 through 5.104 mandate that notice be given and a public hearing be held before important Department decisions are made. Interested persons and governmental agencies are guaranteed an opportunity to present their views.

Sections 5.201 and 5.202 provide for judicial review of Department decisions. The procedures outlined therein are supplemented by various other possibilities of review available at common law.

Sections 5.301 and 5.302 give to the Department civil and criminal sanction which they may use in the enforcement of the statute and the regulations promulgated thereunder.

Repeal, Transfer and Amendment
of Existing Statutes

All references are to the Annotated Code of Maryland, as amended.

Repeal

Article 14B, Secs. 1-4, 7-13.

Article 27, Sec. 485.

Article 43, Secs. 387A, 387B, 389, 393, 394A, 396A, 397.

Article 54, Secs. 45-48.

Article 66C, Secs. 6-13L, 22-30, 33, 234-255, 262-342, 696-717, 756-758.

Article 96A, Secs. 1-58, 76-88.

Transfer

Article 14B, Secs. 4A-4-0 to Article 66-1/2.

Amendments

Article 43

The following sections should be amended to eliminate references to sewage, sanitary facilities and sanitary districts: 387, 388, 390-392, 394, 398, 402, 404-406A.

The following sections should be amended to substitute "Chesapeake Bay Basin Department" for "State Board of Health": 387C, 395.

Article 62B

Section 5(q) should be amended to divest the Maryland Port Authority of power to regulate wharves, bulkheads, piers and piling.

CHESAPEAKE BAY BASIN DEPARTMENT

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ARTICLE 1

CHESAPEAKE BAY BASIN DEPARTMENT

CREATED

Part One

Purposes and Definitions

1.101 – Purposes

It is the intention of the General Assembly in the enactment of this act that the planning, development, management and conservation of the waters of the State, the Chesapeake Bay, and all other tidal waters and tidal resources are the proper responsibility of the State.

1.102 – Definitions

For the purpose of this act, except as may be otherwise required by the context:

- (a) "Department" means the Chesapeake Bay Basin Department created by this act.
- (b) "Director" means the Director of the Chesapeake Bay Basin Department.
- (c) "Person" means an individual, partnership, corporation, joint stock company, firm, society, association or other unincorporated organization, receiver, trustee, and any officer, agent or employee of any of the foregoing acting in his capacity as such, but shall not include governmental agencies or their officers and employees.
- (d) "Governmental Agencies" means the Government of the United States, Maryland, and all other States, their political subdivisions, and every department, agency, commission and other unit or instrumentality thereof and interstate compact commissions.
- (e) "Waters of the State" means all waters, surface and underground, tidal and non-tidal within the boundaries of the State, the Atlantic Ocean bordering on the coast of the State for a distance of three (3) miles from the mean low watermark on the coast, and the flood plain of free-flowing waters determined by the Department as being subject to a fifty (50) year flood frequency.
- (f) "Tidal Waters" means all waters within the boundaries of the State where the tide ebbs and flows, and the Atlantic Ocean bordering on the coast of the State for a distance of three (3) miles from the mean low watermark on such coast.
- (g) "Non-Tidal Surface Waters" means all surface waters of the State which are not affected by the ebb and flow of the tides.
- (h) "Tidal Region" means the entire geographical area embraced by tidal waters and submerged tidal land, and all lands located within one (1) mile of the mean high watermark on tidal waters, and all lands which are one hundred (100) feet above sea level, or less, in Somerset, Worcester, Wicomico, Dorchester, Talbot, Caroline, Kent, Queen Annes, Cecil, Harford, Baltimore, Anne Arundel, Prince Georges, Calvert, Charles, St. Mary's Counties and Baltimore City.
- (i) "Resources of the Tidal Region" means all natural resources within the tidal region including but not limited to, fresh water, tidal water, open space, scenic, historic, wilderness, wetland and other natural areas, harbors, aquatic life, wildlife, sand, gravel, earth, clay, shell deposits, minerals, ore, metals, oil and gas.

- (j) "Aquatic Animal Life" means all species of finfish, crabs, oysters, clams, terrapins, lobsters, zooplankton and all other animal species that live or habitually reside in water.
- (k) "Aquatic Plant Life" means all species of plants that live in water.
- (l) "Tidal Shore Land" means all land within the tidal region except submerged tidal land.
- (m) "Submerged Tidal Land" means all land lying under the tidal waters up to the means high watermark.
- (n) "Project" means any work, service or activity which is determined by the Department to be a separate entity for purposes of evaluation, except that it shall not include the taking of aquatic animal life.
- (o) "Facility" means any real or personal property, structures thereon and improvements thereof, except that it shall not include vessels.
- (p) "Structure" means any assembly of materials above or below the surface of land or water, including but not limited to houses, buildings, plants, bulkheads, jetties, wharves, piers, docks, landings, dams, and waterway obstructions.
- (q) "Development" means the division of land into two or more parcels, the construction, reconstruction, conversion, structural alterations, relocation or enlargement of any structure, or of any excavation or landfill, the filling of submerged land, and any change in the use of any structure, or land, or extension of use of land.
- (r) "Development Regulation" means all regulations which restrict the use and development of land, including but not limited to zoning restrictions, subdivisions controls, master plans and permits procedures placing restrictions on building, construction and filling.
- (s) "Filling" means either the displacement of the waters of the State either by the deposition of sand, gravel, earth or other materials or the artificial alteration of the levels of such waters by structures, drainage ditches or otherwise.
- (t) "Vessel" means every description of watercraft capable of being used as a means of transportation on water or on ice except that it shall not include watercraft moored in the waters of the State at a stationary location on a semi-permanent or permanent basis or sea planes.
- (u) "Court" means the Circuit Court of a county or the Baltimore City Court.

Part Two

Organization

1.201 – Creation

There is hereby created a Chesapeake Bay Basin Department, which shall be part of the Department of Natural Resources.

1.202 – Director

(a) The Governor shall appoint, upon the recommendation of the Secretary of Natural Resources, a competent person with the qualifications prescribed herein as Director of the Chesapeake Bay Basin Department. The Director shall be the head of the Department and shall personally direct its operations and activities. The Director shall be a person with executive ability and experience, and shall have an academic degree and knowledge of the general principles involved in the administration, improvement, planning, management and conservation of the waters of the State and the resources of the tidal region. The Director shall devote his full time to the work of the Department and shall receive such salary as may be provided in the annual State Budget. The Director shall hold office under and subject to the provisions of Section 234(c) of Article 41 of the Annotated Code of Maryland, as amended.

(b) As the head of the Chesapeake Bay Basin Department, the Director shall, subject to the authority of the Secretary of Natural Resources as provided by law, be responsible for the exercise of all the powers and duties conferred upon the Department by the provisions of this act.

1.203 – Staff

The Director shall appoint the staff of the Department, subject to the authority of the Secretary of Natural Resources under Section 234(c) of Article 41 of the Annotated Code of Maryland, as amended, and subject to the provisions of the merit system. The staff of the Department shall consist of such employees as may be necessary to carry out the duties of the Department, in such numbers and at the salaries provided in the annual State Budget. Insofar as the provisions of the merit system provide for disciplinary or dismissal proceedings against employees to be brought by the appointing authority, the Director shall be the appointing authority unless the Secretary of Natural Resources by written directive provides that the Secretary shall be the appointing authority. All employees shall be under the supervision and control of the Director and shall perform such duties as he may prescribe. The Director may require any employee who receives moneys to furnish bond in such amount as the Director may determine.

1.204 – Disposition of Moneys

All moneys received under the provisions of this act from license fees, taxes, fines, penalties, forfeitures, rent, royalties and other sources shall be paid to the Comptroller of the Treasury and credited to general funds.

Part Three

General Powers, Relationship of Department to Federal

Government and Interstate Compact Commissions, Severability

1.301 – General Powers

In addition to the powers specifically delegated to the Department by this act, it shall also have the power to:

(a) supervise, regulate and control the water of the State and the resources of the tidal region;

(b) exercise the powers conferred and perform the duties imposed by all laws hereafter enacted relating to the water of the State and the resources of the tidal region;

(c) enter into contracts, and in its own name sue and be sued;

(d) collect, compile, analyze, interpret, coordinate, tabulate, summarize, and distribute technical and other data, and conduct studies, sponsor research and prepare reports on resource problems of the State;

(e) prepare, publish and disseminate information and reports in relation to the waters of the State and the resources of the tidal region and on the views, policies and recommendations of the Department in relation thereto;

(f) establish standards to guide the construction, operation and management of projects and facilities;

(g) plan, design, acquire, construct, reconstruct, complete, own, improve, extend, develop, operate, maintain, and regulate any and all projects, facilities, properties, activities and services, determined by the Department to be necessary, convenient or useful for the purposes of this act;

(h) negotiate for such loans, grants, services, or other aids as may be available from public or private sources to finance or assist in effectuating any of the purposes of this act;

(i) adopt, amend and repeal such rules and regulations as it may deem appropriate for the effectuation and enforcement of this act;

(j) institute an action or actions in its own name to compel compliance with any and all of the provisions of this act or any of the rules and regulations of the Department adopted pursuant thereto;

(k) acquire real or personal property and any interest therein as it may deem appropriate for carrying out its functions under this act, by eminent domain;

(l) hold, administer, maintain and dispose of real and personal property and any interest therein as it may deem appropriate for carrying out its functions under this act;

(m) sell or dispose of any of its products or services and make charges in connection with the use of any of its facilities;

(n) conduct such investigations and inspections as it may deem appropriate to carry out its functions under this act;

(o) undertake or contract for with any private or governmental organization, laboratory or research group, studies, surveys and experiments concerning the water resources of the State.

1.302 – Relationship of Department to Federal Government and Interstate Compact Commissions

(a) Nothing in this act shall in any way impair the powers of the United States or of any agency or department thereof, over public waters. Should any conflict arise between the powers of the United States and those of the Department under this act, the conflicting provisions of this act shall be abrogated to the extent of the conflict.

(b) For all purposes the Department shall be considered the successor to the duties and powers of the Tidewater Fisheries Commission as such duties and powers are specified in the Potomac River Compact of 1958. To the extent that the terms of this Compact limit, restrict or otherwise conflict with the powers of the Department under this act, the Compact provisions shall take precedence. After the effective date of this act, the Maryland members of the Potomac River Fisheries Commission shall be appointed by the Director.

(c) To the extent that any interstate compacts other than the Potomac River Compact of 1958 to which the State is now or may become a party concern all or part of the waters of the State, or the resources of the tidal region, the Department shall be the coordinating and enforcing agency of the State and shall perform all activities and functions which devolve upon the State under the compact. To the extent that any such compact may limit, restrict or conflict with the powers of the Department under this act, the compact provisions shall take precedence.

1.303 – Severability

If any provision of this act or the application thereof to any person or governmental agency is held invalid, such invalidity shall not affect the other provisions or any other application of the act which can be given effect without the invalid provision or application, and to this end the provisions of this act are declared to be severable.

ARTICLE 2
WATERS OF THE STATE

Part One

Water Plan

2.101 – Development, Adoption and Contents

The Department shall develop and adopt and, from time to time, review, revise and amend a plan for development, conservation, utilization and management of the waters of the State, and may adopt such plan or any revision thereof in such part or parts as it may deem appropriate. The water plan shall include, but need not be limited to, determinations of immediate and long-range needs and objectives, classifications of water uses which are to be protected and preserved, and projects and facilities, governmental or private, which the Department determines are necessary or useful for the optimum development, conservation, utilization and management of the waters of the State.

2.102 – Relationship to Other Plans

The water plan shall be complementary to the plan for the tidal region provided for by Section 3.101 of this act, and the Department, in developing, reviewing, revising and amending the water plan shall give consideration to relevant portions of Federal, State, regional and local plans.

Part Two

Water Quality Control

2.201 – Water Quality Standards

(a) In implementing the water plan the Department, by regulation, shall adopt, and may from time to time change, the following: water quality standards for the waters of the State; standards of water quality for particular waters of the State; criteria of water quality for each classification of water use established by the comprehensive water plan; standards and methods of preserving, regulating, controlling and improving water quality; definitions of pollution and identification of pollutants.

(b) Standards of water quality and criteria of water quality may relate, but need not be limited to bacterial, viral, chemical, radioactive, organic, thermal, gaseous, liquid, solid or soil additions to the waters of the State from any source, or to enrichment of the waters of the State from any source.

(c) No person or governmental agency shall discharge any effluents into the waters of the State which interfere with maintenance of the standards and criteria of water quality adopted by the Department. The Department may, by regulation, require that any person or governmental agency discharging effluent into the waters of the State shall monitor the quality

of such effluent and make reports to the Department, or that the Department shall monitor the quality of such effluent itself and charge such person or governmental agency the expense thereof.

2.202 – Other Water Quality Controls

(a) The Department may require that any person or governmental agency secure a permit, as the Department may prescribe by regulation, before discharging effluent into the waters of the State. In the issuance of such permits the Department may impose such limitations on the duration, location, nature and quality of the effluent as it may find necessary for the effective maintenance of the water quality standards it has promulgated.

(b) The Department may, by regulation, require that persons or governmental agencies discharging effluent into the waters of the State pay a charge to the Department. If the Department imposes such charges, it shall prescribe, by regulation, reasonable standards for the determination of the amount.

(c) The Department may, by regulation, require vessels registered in the State to carry waste collection and disposal equipment of a type suited to reduce the deposition in the waters of the State of human and other sewage and waste.

(d) The Department may adopt any other regulations necessary for the implementation and enforcement of the water plan and the water quality standards for the waters of the State.

2.203 – Existing Discharges

The fact that any person or governmental agency has, prior to the effective date of this act, been discharging effluent at a given location, in a given quantity or of a given quality shall in no way be considered to exempt such person or governmental agency from any procedures the Department may adopt pursuant to this act to regulate and control effluent discharges and water quality.

2.204 – Defense in Private Suit

In any suit brought by any person or governmental agency against any other person or governmental agency for reducing the quality of water or for rendering it harmful or noxious or for in any way affecting the usefulness of the water, proof that the defendant is acting within all the applicable regulations and procedures of the Department shall be a complete defense to the action.

2.205 – Transition

All water quality standards, regulations, controls and effluent permits in effect on the effective date of this act shall continue in full force and effect until changed, amended or modified by the Department pursuant to the provisions of this act.

Part Three

Use of Waters

2.301 – General Powers

In implementing the water plan the Department may adopt regulations it deems necessary for the optimum development, conservation and utilization of the waters of the State.

2.302 – Uses by Persons

(a) No person may use, divert, or appropriate, consumptively or non-consumptively, any of the waters of the State without first securing a permit from the Department pursuant to such regulations as the Department shall prescribe, except that the Department may, by regulation, exempt from the requirements of this Section such uses, diversions or appropriations as it may reasonably find to have a minimal effect on the waters of the State. The Department shall only issue a permit if it determines that the contemplated use, diversion or appropriation is in the public interest as a practicable and efficient utilization of the waters of the State and will not adversely affect either the water plan or such part or parts thereof which have been adopted. Any person issued a permit which entails the use, diversion or appropriation of tidal waters shall comply with the procedure in Section 3 203 of this act before starting such use, diversion or appropriation.

(b) Permits issued under this Section shall specify the character, location and duration of the use, diversion or appropriation, the methods to be applied in its execution and such other conditions, restrictions or qualifications as the Department deems necessary to insure conformity with the water plan.

(c) Permits issued pursuant to this Section shall not create any vested rights and may not be sold, assigned or transferred, and do not become appurtenant to land. The Department shall periodically review such permits at least once every five (5) years and may revise, amend or revoke them in effectuating the comprehensive water plan and the comprehensive plan for the tidal region.

(d) Any person having a vested right to use, divert or appropriate any water of the State by virtue of prior statute or of common law who is refused a permit to exercise such right or granted a permit with conditions, restrictions or qualifications which derogate such right, may petition a court as provided in Section 5 201 of this act to determine whether the action of the Department is an unreasonable exercise of the police power and therefore constitutes a taking of property without compensation. If the court finds the action of the Department to be a taking of property without compensation the court shall order the Department to issue an appropriate permit but the order shall not affect the rights of any other person.

2.303 – Uses of Governmental Agencies

No governmental agency may use, divert or appropriate, consumptively or non-consumptively, any of the waters of the State without first securing the approval of the Department. The Department shall, by regulation, prescribe the procedure to be followed in securing such approval.

2.304 – Transition

All rules, regulations and permits relating to the use, diversion or appropriation of waters of the State in effect on the effective date of this act shall remain in effect until changed, amended or modified by the Department pursuant to the provisions of this act.

Part Four

Boating

2.401 – General Powers

In implementation of the water plan and the plan for the tidal region, and to protect public safety and welfare the Department may, by regulation, prescribe the type, size and description of all vessels which may be operated on the waters of the State, the place where they may be operated and the manner of operation.

2.402 – Safety

The Department may, by regulation, impose restrictions on the operation of vessels that it deems appropriate to protect public safety, including but not limited to, requirements that vessels carry safety equipment, speed limits and restrictions on water skiing and aquaplaning.

2.403 – Enforcement

The Department is charged with the primary duty of enforcing the provisions of this act relating to the use of vessels and the regulations promulgated thereunder, and officers, agents or employees of the Department are authorized to stop and inspect vessels in the exercise of this duty.

2.404 – Transfer of Powers

All powers and duties relating to the numbering, identification, certificates of title, sale, assignment or transfer, fees and excise taxes, liens, licensing of manufacturers or dealers of, for, or on vessels and the reporting of boating accidents, found in Article 14B, Sections 1-10 of the Annotated Code of Maryland, as amended, on the effective date of this act are herewith transferred to the Department of Motor Vehicles.

2.405 – Transition

All rules and regulations governing the operation and use of vessels in the waters of the State in effect on the effective date of this act and all laws relating to the operation and use of vessels in the waters of the State which are repealed by this act, shall remain in effect as regulations of the Department until changed, amended or modified by the Department pursuant to the provisions of this act.

ARTICLE 3

THE TIDAL REGION

Part One

Plan for the Tidal Region

3.101 – Development and Adoption

The Department shall develop and adopt and, from time to time, review, revise and amend a plan for the development, conservation, utilization and management of the resources of the tidal region, and may adopt such plan or any revision thereof in such part or parts as it may deem appropriate. The plan for the tidal region shall generally comprise a report or statement of development and conservation proposals with maps, diagrams and text, and shall include, but need not be limited to:

- (a) a determination of immediate and long-range needs and objectives;
- (b) a land use plan element, showing the existing location, extent and intensity of uses of tidal shore land and submerged tidal land, and providing standards for the development of such lands for residential, commercial, industrial, agricultural, recreational, maritime and fishing purposes, so as to encourage multiple compatible uses of such land, to effect a reconciliation of alternative and conflicting uses of such lands and to enhance public access to tidal waters;
- (c) a circulation plan element showing the location and types of facilities for all modes of transportation by land, water and air required for the efficient movement of people and goods into, about and through the tidal region, including terminals, facilities and rights of way;
- (d) a utility service plan element analyzing the need for and showing the future location of facilities for water supply and distribution, drainage, sewage and waste treatment and solid waste disposal and provision for other related utilities;
- (e) a recreation plan element showing a comprehensive system of areas and public sites for recreation, including the following, with their locations and proposed development: natural reservations, parks, parkways, bicycle paths, trails, beaches, vista points and other recreational facilities;
- (f) a conservation plan element for the conservation, development and utilization of natural resources, including open space, fresh water, tidal waters, forests, soils, marshes, wetlands, harbors, shore land, submerged land, aquatic life, wildlife, sand, gravel, earth, clay, shell deposits, minerals, ore, metals, oil, gas and other resources of the tidal region;
- (g) an economic development plan element providing for the development and maintenance of full employment opportunity.

3.102 – Relationship to Other Plans

The plan for the tidal region shall be complementary to the water plan provided for by Section 2.101 of this act, and the Department, in developing, reviewing, revising and amending the plan for the tidal region shall give consideration to relevant portions of Federal, State, regional and local plans.

Part Two

Rights in Tidal Waters and Submerged Tidal Lands

3.201 – Ownership of Tidal Waters and Submerged Tidal Lands

The State of Maryland owns all tidal waters and all submerged tidal land except to the extent that such submerged tidal lands have been transferred by the State by a valid and extant grant, lease or patent, or by a valid and extant grant confirmed by Article 5 of the Declaration of Rights of the Constitution of Maryland.

3.202 – Riparian Rights in Tidal Waters and Submerged Tidal Lands

Except to the extent given other rights by statute, persons owning land bounding on tidal waters shall, by virtue of such ownership, only have the following rights in tidal waters and submerged tidal lands:

- (a) the right of access to tidal waters;
- (b) the right to land formed by natural accretion in front of such land;
- (c) the right to build in front of such land for non-commercial use, landings, wharves, docks or shore erosion control structures, any of which upon completion becomes their property. The exercise of these rights is subject to the regulatory procedure in Sections 4.201 and 4.302 of this act and to all other regulatory powers given by law to any governmental agency.

3.203 – Transfer of the State's Interest

Any person issued a permit to use, divert or appropriate tidal waters under Section 2.302, or to engage in a project under Section 4.302 shall, before starting on such use, diversion, appropriation or project, present the permit to the Director, who shall be the trustee of tidal waters and submerged tidal lands owned by the State. The Director shall review the use, diversion, appropriation or project authorized by the permit and shall determine the extent to which it requires the use or taking of tidal waters, submerged tidal land or other resources owned by the State. The Director shall determine the consideration, if any, which the person shall be required to transfer to the State in return for such use or taking, the nature and terms of payment and the statements which the person shall be required to furnish the Department, provided that the Director shall not require any person owning land bounding on tidal waters to transfer any consideration in payment for the exercise of rights given such person under Section 3.202. The Director shall set forth his determinations in an order which shall be published once a week for two successive weeks in a newspaper having general circulation in the area of the use, appropriation, diversion or project and the order shall not become final unless it remains unrevoked ten (10) days after final publication. After the order becomes final the Director shall be empowered to transfer in the name of the State any interest in real or personal property necessary for the use, appropriation, diversion or project to be pursued. Any person who fails to comply with the terms of the order shall forfeit the permit and all interests in real or personal property transferred to him by the Director.

Part Three

Tidal Shore Lands Controls

3.301 – Designation of Areas of Restricted Development

The Department may, pursuant to such procedures as it shall prescribe, by regulation, designate all or any portion of the shore lands of the tidal region as areas of restricted development upon a finding that additional controls on land development are necessary within such area or areas to implement the plan for the tidal region. The Department may, from time to time, revise or abolish such designations. Any shore lands designated as an area of restricted development may not be used for any purpose other than that for which they were actually and lawfully being used when they were so designated, except as authorized by the provision of Section 3.302 or Section 3.303.

3.302 – Jurisdiction of Other Governmental Agencies

Any other governmental agency having land use control jurisdiction over a portion of shore lands designated as an area of restricted development may submit to the Department development regulations governing such portion of shore lands. If the Department finds that such development regulations meet or exceed the minimum requirements of the plan for the tidal region it shall approve them, but the Department shall not approve any such development regulations unless they provide that, insofar as the Department may prescribe, any changes in, or special exceptions or variances thereafter made or authorized relating to the use to which any land may be put, shall not become effective until accepted by the Department. If the Department has approved the development regulations of another governmental agency, such governmental agency shall enforce them and the development of land in such area of restricted development may be authorized as provided therein. Approval may be revoked if the Department finds that development regulations are not being adequately enforced or no longer meet the minimum requirements of the plan for the tidal region due to a revision of such plan.

3.303 – Jurisdiction of the Department

The Department shall, by regulation, prescribe development regulations for any area designated as an area of limited development if the Department has not approved the development regulations of any other governmental agency or if such approval has been revoked. Such development regulations shall implement the plan for the tidal region, and the development of land in such areas of restricted development may be authorized as provided therein. The Department shall have discretion, by regulation, to, from time to time, revise or abolish such development restriction in whole or part.

Part Four

Aquatic Life

3.401 – General Powers

(a) The Department may, by regulation, prescribe the type, size and description of all aquatic animal life which may be taken from tidal waters or submerged land, the places where they may be taken and the manner of taking.

(b) The Department is empowered to inspect all aquatic animal life taken from tidal waters or submerged tidal land and all aquatic animal life sold within the State, pursuant to such regulations as it may prescribe. The Department may, by regulation, prescribe the type, size and description of aquatic animal life which may be sold within the State or exported without the State.

(c) The Department may, by regulation, prohibit the importation of any aquatic animal life from sources outside of the State when there is a reasonable suspicion that such aquatic animal life might be harmful to the aquatic animal life of the tidal waters.

3.402 – Licenses

(a) The Department shall issue such licenses as it may prescribe, by regulation, which shall thereupon be required for the taking, buying, selling, marketing, packing, or canning of aquatic animal life from tidal waters or submerged land, and for boats, vessels and equipment used for such taking, buying, selling, marketing, packing or canning.

(b) The Department shall, by regulation, prescribe the qualifications necessary for obtaining such licenses, the privileges granted by such licenses, the fees for such licenses and the manner and extent to which such licenses may be transferred.

3.403 – Oyster and Shellfish Leases

(a) The Department is empowered, in the name of State, to lease to any person parcels of submerged tidal land to be used for protecting, sowing, bedding or cultivating oyster or other shellfish. The Department shall, by regulation, prescribe the procedures and qualifications necessary for obtaining such leases, the portions of submerged land available for such leases and the extent to which such leases can be transferred or assigned.

(b) The Department shall only grant the lease if it deems the lease to be in the best interests of the State, provided that no lease shall be granted which is incompatible with the water plan or the plan for the tidal region, and that no lease shall be granted which infringes upon the rights of any other person under Sections 3.202 or 4 302 of this act, or under this Section, unless such person gives his written consent.

(c) The Department shall set forth in all leases granted under this Section the duration, location, size of parcel, consideration, terms of payment and the statements the lessee is required to make. Any person who fails to comply with these terms of the lease shall forfeit his rights under the lease.

3.404 — Transition

All laws relating to the taking, buying, selling, packing or canning of aquatic animal life from tidal waters or submerged tidal land and all laws relating to the importation or exportation of aquatic animal life to and from the State which are repealed by this act shall remain in effect as regulations of the Department until changed, amended or modified by the Department pursuant to this act; except that all taxes on the taking, buying, selling, marketing, packing or canning of aquatic animal life from tidal waters or submerged land, and all taxes on the importation or exportation of aquatic animal life to or from the State, in effect when this act is enacted shall continue in force and effect until changed, amended, modified or repealed by the General Assembly. The Department, within two years after the effective date of this act, shall present to the General Assembly a proposed revision of such taxes for its consideration.

ARTICLE 4

PROJECT AND FACILITIES

Part One

General Powers

4.101 – Programs

The Department shall, from time to time, formulate and adopt programs based upon the water plan and the plan for the tidal region, determining the quality and quantity of water needs of the State and the needs for conservation, enhancement and development of the resources of the tidal region, and proposing projects and facilities to be undertaken by persons, other governmental agencies and the Department in satisfaction of such needs.

4.102 – Assistance

The Department shall provide administrative and technical assistance to persons and governmental agencies in the development of coordinated programs for the implementation of the water plan and the plan for the tidal region and for the planning and design of projects and facilities in conformity with the water plan and the plan for the tidal region.

4.103 – Recommendations

The Department may recommend to persons or governmental agencies that they acquire, construct, operate or maintain projects and facilities as the Department may deem appropriate for the implementation of the water plan or the plan for the tidal region.

Part Two

Regulation of Projects and Facilities

4.201 – Regulations

(a) The Department shall, by regulation, establish standards for the construction, operation and maintenance of projects and facilities which the Department deems necessary to implement the water plan and the plan for the tidal region, in or upon non-tidal surface waters, the flood plain of freeflowing waters determined by the Department as being subject to a fifty (50) year flood frequency, tidal waters or submerged tidal lands, or which are used to appropriate underground water, to assure the optimum development, conservation and utilization of the waters of the State and the resources of the tidal region and to protect the public health, safety and welfare.

(b) No person or governmental agency shall construct, operate or maintain any such project or facility in violation of these standards.

4.202 – Enforcement

The Department may, at reasonable times, inspect any projects and facilities within the purview of Section 4.201 to determine whether such projects and facilities are being constructed, operated and maintained in compliance with the regulations promulgated thereunder. If the Department finds that such regulations are not being complied with it may issue an order requiring the person or governmental agency to cease construction or operation, to change his mode of construction, operation or maintenance or to make necessary repairs or alterations, so as to comply with such regulations. If such person or governmental agency fails to comply with an order to make repairs or alterations, the Department may make such repairs and alterations and charge such person or governmental agency the expense thereof.

Part Three

Approval of Projects

4.301 – Projects on Non-Tidal Waters by Persons

No person shall undertake any project in or upon non-tidal surface waters or the flood plain of free-flowing waters determined by the Department as being subject to a fifty (50) year flood frequency or which will be used to appropriate underground water without first having secured the approval of the Department pursuant to such regulations as the Department may prescribe except that the Department may, by regulation, exempt from the requirements of this Section such projects as it may reasonably find to have a minimal effect upon the waters of the State. Projects within the purview of this Section shall include, but not be limited to, the following:

- (a) building, maintaining or modifying of any structure in or upon non-tidal surface waters or the fifty (50) year flood plain;
- (b) constructing, maintaining or modifying any reservoir or pond;
- (c) changing or diminishing the course or current of any non-tidal surface waters;
- (d) changing the configuration of the fifty (50) year flood plain;
- (e) drilling or digging of wells, test holes or other borings.

The Department shall only approve such project if it determines that it will not adversely affect the water plan or such part or parts thereof which have been adopted and will not interfere with maintenance of the standards and criteria of water quality established by the Department.

4.302 – Projects on Tidal Waters by Persons

(a) No person shall undertake any project in or upon tidal waters or submerged tidal lands without first securing a permit from the Department pursuant to such regulations as the Department shall prescribe, except that the Department may, by regulation, exempt from the requirements of this Section such projects as it may reasonably find to have a minimal effect on the tidal region. Projects within the purview of this Section shall include, but not be limited to, the following:

- (1) the building, maintaining or modifying of any structure on tidal waters or submerged tidal lands;

(2) the mooring of floating structures in tidal waters at a stationary location on a semi-permanent or permanent basis;

(3) the filling of submerged tidal lands or the disposal of dredged materials in tidal waters;

(4) the dredging, taking or extracting of any sand, gravel, earth, clay, shell deposits, minerals, ore, metals, oil or gas or other materials from tidal waters or submerged tidal lands, except that it shall not include the taking of aquatic animal life.

Before issuing a permit the Department shall consider the potential effects of the project on the waters of the State and the resources of the tidal region and, giving due regard to the need for encouraging multiple compatible use of the waters of the State and the resources of the tidal region and for effecting a reconciliation between alternative and conflicting use, shall only issue a permit if it deems the project in the public interest, provided that no permit shall be issued for any project which adversely affects either the water plan or the plan for the tidal region, or such part or parts thereof as have been adopted, and that no permit shall be issued for any project which will derogate the rights of any person under Sections 3.202 or 3.403 of this act or under this Section, unless such persons give their written consent. Any person issued a permit under this Section which entails the use or taking of tidal waters, submerged lands or other resources owned by the State shall comply with the procedure in Section 3.203 of this act before starting such project.

(b) Permits issued under this Section shall specify the character, location and duration of the project, the method to be employed in its execution and such other conditions, restrictions or qualifications as the Department deems in the best interest of the State.

(c) Any person having a vested right in tidal waters or submerged tidal land by virtue of a valid and extant grant, lease or patent or by prior statute or common law, who is refused a permit to exercise such rights, or is granted a permit with conditions, restrictions or qualifications which derogate such right, may petition a court as provided in Section 5.201 of this act to determine whether the action of the Department is an unreasonable exercise of the police power and therefore constitutes a taking of property without compensation. If the court finds the action of the Department to be a taking of property without compensation the court shall order the Department to issue an appropriate permit but the order shall not affect the right of any other person or governmental agency.

4.303 – Projects by Governmental Agencies

No governmental agency shall engage in any projects which affect the waters of the State or the resources of the tidal region without first securing the approval of the Department. The Department shall, by regulation, prescribe the procedure to be followed in securing such approval.

Part Four

Acquisition, Operation, Management and Financing of Projects

and Facilities by the Department

4.401 – General Powers

(a) The Department, alone or in cooperation with one or more persons or governmental agencies, may acquire, construct, operate, maintain and administer such projects and facilities

as it deems appropriate for the implementation of the water plan and the plan for the tidal region.

(b) Facilities within the purview of this Section include, but are not limited to the following:

- (1) sewage or waste collection systems, treatment plants and related facilities;
- (2) systems for the collection, storage, appropriation, transmission, sale or exchange of waters;
- (3) marine terminals and other improvements to waterways for navigational purposes;
- (4) parks, recreation, scenic and historic areas including open space, development rights and easements;
- (5) natural areas including wetlands, marsh and other areas suitable for the propagation of fish and wildlife;
- (6) shore erosion control devices.

(c) Projects within the purview of this Section include, but are not limited to, all activities incident to the construction, operation and maintenance of such facilities and the clearing of debris, aquatic plant life and obstructions from waters of the State, the dredging and marking of channels, and the repletion of fishery resources.

(d) In operation, maintenance and administration of such projects and facilities the Department may act through public or private lessees or concessionaires.

4.402 – Acquisition

(a) The Department may acquire such facilities by purchase, gift, grant, devise, bequest, lease, condemnation, exchange or otherwise.

(b) The Department may, in the acquisition of such facilities by condemnation, take property already devoted to a public use.

(c) The acquisition of interests or rights in real property for the preservation of open spaces and areas constitutes a public purpose for which public funds may be expended.

4.403 – Financing

(a) The Department may contribute all or a portion of the costs of acquisition, construction, operation, maintenance or administration of any project or facility by the Department or by some other governmental agency.

(b) The Department may contribute all or a portion of the costs of acquisition, construction, operation, maintenance and administration of any project or facility by the Department in cooperation with one or more persons, or by one or more persons, provided that the Department finds that the benefits to the State from such contribution equal or are greater than the amount of the contribution.

(c) Department contributions may be used to match Federal funds that may be or become available.

ARTICLE 5

GENERAL PROVISIONS

Part One

Administrative Procedures

5.101 – Rules and Regulations

(a) The Department shall adopt, amend and repeal, and prescribe the effective dates for rules of procedures for all activities it is authorized to undertake, and for regulations it may deem necessary or desirable for the implementation and enforcement of this act, or to carry out its responsibility under this act.

(b) The Department shall prepare and provide for the editing, publishing, compiling and indexing of all such rules and regulations.

(c) Any person or governmental agency may petition the Department requesting the promulgation, amendment or repeal of any rule or regulation. The Department shall prescribe by rule the form for such petitions and the procedure for their submission, consideration and disposition.

5.102 – Notice and Hearing Required

In addition to when required by other provisions of this act, notice shall be given and a hearing held whenever the Department makes or takes the following decisions or actions:

(a) the adoption, amendment or repeal of rules and regulations except those relating solely to the internal management of the Department; (b) the adoption, revision, amendment or repeal of the water plan or the plan for the tidal region, or part or parts thereof; (c) the issuance, revision or revocation of permits; (d) the approval or refusal to approve of projects; (e) the designation of all or any portions of the shore lands of the tidal region as areas of restricted development and revisions or abolition of such designations; (f) the approval or disapproval of development regulations submitted by other governmental agencies and any revocation of such approval; and (g) the leasing of parcels of submerged tidal lands to be used for protecting, sowing, bedding or cultivating of oyster or other shellfish.

5.103 – Notice

(a) Unless otherwise specified in this act whenever notice is required it shall be given by publication once a week for two successive weeks in a newspaper having general circulation in the area, or portion or portions of the State to be affected by the proposed action of the Department. If the purpose of such notice is to give notice of a proposed public hearing, the notice shall identify the subject or subjects to be considered and specify the time, not less than ten (10) days after final publication, and place of hearing at which interested persons or governmental agencies may appear and present their views. In addition to newspaper publication, notice of the proposed action of the Department, or of the public hearing, shall be posted in a conspicuous place at the offices of the Department.

(b) The Department may mail a copy of the notice to each person and governmental agency which the Department believes may be affected by the proposed action of the Department or by

the action it may take after such public hearing, and may also mail a copy of the notice to any other person or governmental agency who shall request such notice. The Department may provide for other means of giving notice to the end that all persons and governmental agencies having an interest in the subject may reasonably be apprised thereof. Any failure of the Department to give notice as provided in this paragraph (b) shall not affect the validity of any action taken by the Department.

(c) The notice need not contain the entire text, plan, or detail of the proposed action of the Department or of the subject matter of the hearing, but shall reasonably identify the same and state the place at which the same may be examined. Whenever copies of such text, plans, or details may be provided by the Department, the notice shall so state and shall give the post office address to which requests for such data may be sent and the price, if any, charged by the Department therefor.

5.104 – Hearings

(a) The Department shall, after notice and at such place or places as it may determine, conduct at least one public hearing, whenever a hearing is required by this act. Any person or governmental agency claiming to have an interest in the subject matter of the proposed action by the Department shall be entitled to submit data or views at such public hearing.

(b) The Department in the conduct of hearings may admit and give probative force to evidence which possesses probative value commonly accepted by reasonably prudent men in the conduct of their affairs and may take notice of judicially cognizable facts and other general, technical, or scientific facts within its specialized knowledge.

(c) The Department shall adopt rules and regulations governing hearings, including rules of practice and procedure and may prescribe the form and content of pleadings and other documents that may be filed with the Department.

(d) Department hearings may be conducted by the Director or such person or persons as the Director may direct. The Director or any person authorized by the Director may administer oaths and affirmations, examine witnesses and receive evidence at a hearing. Any willful false swearing or affirming at a hearing as to any material fact shall be deemed perjury under the law of the State.

(e) Any final order, decision or action taken after hearing shall be in writing or stated in the record and shall be accompanied by findings of fact and conclusions of law.

5.105 – Subpoenas

The Director or any persons authorized by the Director may issue subpoenas in the name of the Department to compel witnesses to appear and testify or to produce books, records, papers, documents or other tangible forms of evidence relating to any matter within the authority of the Department.

5.106 – No Review by Board of Review

The Board of Review of the Department of Natural Resources shall have no power to review any order, decision or action taken by the Department.

Part Two

Judicial Review

5.201 – Review

(a) Upon the petition of any person or governmental agency aggrieved, any final order, decision or action of the Department made or taken after hearing or with respect to which a hearing is required, and any other order, decision or action which this act provides shall be subject to judicial review, may be reviewed by any court of competent jurisdiction. The petition for review shall be filed within thirty (30) days after the date of such order, decision or action of the Department. Upon the filing of the petition the Clerk of Court shall forthwith, by mail, serve a copy thereof upon the Department which shall thereupon file in the court a certified list of the materials comprising the record of the proceedings and hold for the court all such materials and transmit the original or certified copies of the same or any part thereof to the court, when and as required by it, at any time prior to the final determination of the review.

(b) The filing of a petition for review shall not operate as a stay of the operation of such order or decision unless so ordered by the Department or by the court for good cause shown. For good cause shown, and upon such conditions as may be required and to the extent necessary to prevent irreparable injury, the court may take appropriate and necessary action to preserve the status quo or rights of any of the parties, or others, pending conclusion of the review proceedings.

(c) The court without a jury shall hear and decide the review on the record of proceedings before the Department, and may affirm the decision of the Department or remand the case for further proceedings; or it may reverse or modify the decision if the findings, conclusions or decision, are (1) in violation of constitutional or statutory provisions, or (2) in excess of the authority of the Commission, or (3) made upon unlawful procedure, or (4) affected by other error of law, or (5) unsupported by substantial evidence on the record considered as a whole, or (6) arbitrary, capricious, or an abuse of discretion. The court may appoint a special master to take evidence and make recommendations to the court with respect to any question raised in a petition for review if the court is of the opinion that the question can not be adequately determined from the record of the proceedings before the Department and that the interest of justice so requires.

5.202 – Appeal

Any petitioner may secure a review of any final judgment of the court by appeal to the Court of Appeals. Such appeal shall be taken in the manner provided by law for appeals from law courts in other civil cases.

Part Three

Enforcement by the Department

5.301 – Injunction

The Department may enforce or require compliance with any provision of this act or any rule, regulation, decision or order of the Department made pursuant thereto, or restrain any

violation of any such provisions, rule, regulation, decision or order, by injunction or any other appropriate action brought in the name of the Department in a court.

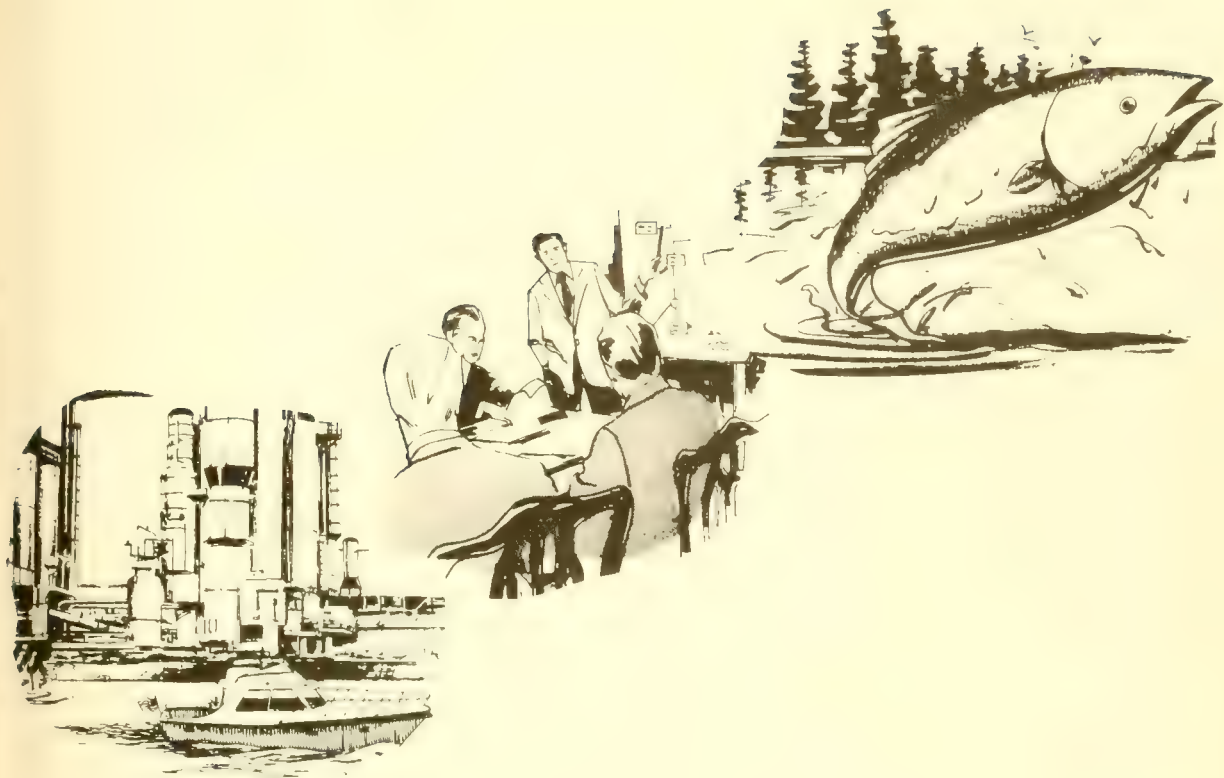
5.302 -- Penal Sanctions

(a) Any person violating any provision of this act or regulation of the Department, other than one of a procedural nature or relating solely to the internal management of the Department, shall be guilty of a misdemeanor and, upon conviction, shall be punished by a fine not exceeding five hundred dollars (\$500.00) for each offense. Each day during which a violation occurs shall be deemed a separate and additional violation. The employees of the Department assigned to law enforcement duties and all other law enforcement officers are authorized and directed to enforce the provisions of this act and the regulations of the Department, and to make arrests for violation thereof.

(b) Notwithstanding any criminal liability, any person violating any provision of this act or any regulation of the Department shall be civilly liable to the Department for any actual damage sustained by the Department by reason of such violation.

(c) The penal sanctions herein provided shall not be applicable to any failure or refusal to pay any charge imposed by the Department.

* * *



Part VI
DEVELOPMENT OF DATA ON THE ESTUARINE ZONE

INTRODUCTION

As required by Sec. 5g of the Clean Water Restoration Act of 1966, the National Estuarine Pollution Study, acting on behalf of the Secretary of the Interior

" . . . shall assemble, coordinate, and organize all existing pertinent information on the Nation's estuaries and estuarine zones; carry out a program of investigations and surveys to supplement existing information in representative estuaries and estuarine zones; and identify the problems and areas where further research and study are required . . . "

To fulfill both the spirit and the letter of the Act, the National Estuarine Pollution Study acquired and consolidated all available existing information in the form of the National Estuarine Inventory, an automated framework for organizing the tremendously large mass of data assembled. The Study conducted investigations and inquiries both to acquire and to develop this available information. As a corollary, the data assembly was also useful in defining areas where data and information are not available and are needed. The data gaps, in turn, were used in conjunction with state-of-the-art studies designed to identify necessary research and study.

Consequently, these two phases of the Study -- assembly of data and definition of research and study needs -- being so closely related, are presented together in this part of the report. The first

chapter discusses the National Estuarine Inventory, its development, and its past and future applications. Chapter 2 points out the major data gaps as shown by the Inventory and sets out a program for a needed data acquisition, analysis, and interpretation.

In Chapter 3 the results of the research and study needs investigations are outlined in some detail.

Two basic programs are outlined in Chapters 2 and 3. The first is to satisfy the need for basic data: that is, numbers and information which can be analyzed and interpreted to give information. The second program is designed to search for basic knowledge: that is, the understanding necessary to clearly and unmistakably use the basic data.

The tying together of what-is-known to show what-is-not-known, is a common denominator in these two programs. Of necessity, some overlap appears, pointing up the fact that the search for knowledge results in data, and the search for data results in knowledge.

THE NATIONAL ESTUARINE INVENTORY

"In conducting the . . . study, the Secretary shall assemble, coordinate, and organize all existing pertinent information on the Nation's estuaries and estuarine zones . . ."

Clean Water Restoration Act of 1966

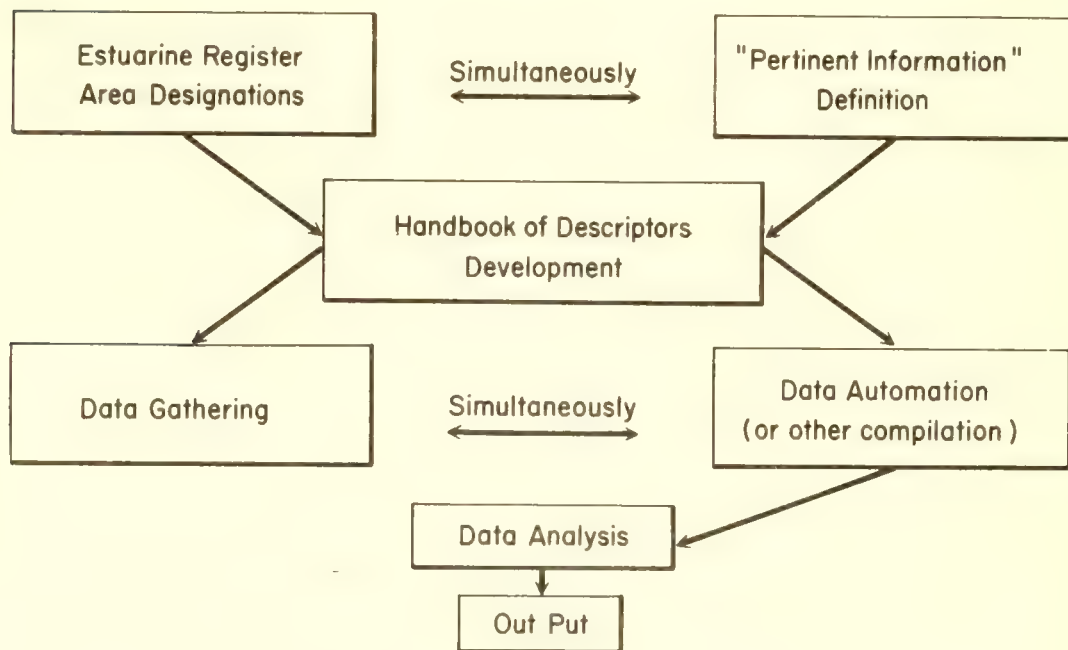
Section 5(g) (2)

The National Estuarine Inventory is the primary repository of the quantitative documentation used in the National Estuarine Pollution Study to describe the Nation's estuarine system, its uses and problems. While the directive calling for this Study did not explicitly require an inventory, the breadth of information required implicitly demanded inventory techniques, including automation.

The Inventory differs from a basic data storage-and-retrieval system in three respects: First, the intent is to supply information for institutional and technical management rather than for scientific analyses, thus introducing a very wide variety of information and also preventing duplication of existing federally-financed data systems. Second, to increase its value to the estuarine manager, much material has been entered as statistical summaries rather than in raw data form; and, third, information which does not readily lend itself to automation techniques has been "assembled, coordinated, and organized" by other methods.

This discussion describes in some detail the selection of the descriptors used; the sources of information; how the information was collected, organized, and automated (Figure VI.1.1); the present status of the data bank; and the need for, and value of, a management information system based on this system.

Figure VI.1.1
DEVELOPMENT OF THE NATIONAL ESTUARINE INVENTORY



SECTION 1. THE HANDBOOK OF DESCRIPTORS

The framework around which the Inventory is built is the "Handbook of Descriptors" (VI-1-1), an outline showing the information necessary to describe the Nation's coastal areas.

The original list of descriptors, developed within the Federal Water Pollution Control Administration (FWPCA), was reviewed in detail by other agencies of the Department of the Interior and a number of state water pollution control and natural resource agencies. Critical review by this diverse group helped to build a more comprehensive data base than otherwise would have resulted.

COMPOSITION OF THE HANDBOOK

The "Handbook" is comprised of the outlines for the two basic types of management information needed to work with any estuarine system. It contains sets of blank forms and instructions for their completion with specific data. First, there must be institutional management information consisting of those kinds of information which would be required by a responsible management entity to determine: the most nearly optimum use balance; the kind of organization which could achieve and maintain the balance most effectively; whether such an organization exists; and the existing institutional framework within which it must work. Such information would include the political make-up, i.e., the States, counties, municipalities, and special districts involved; groups with management responsibilities in the system; existing zoning restrictions; water quality standards; economic make-up of the area;

present and historical uses; sources of pollution; and damages to use from pollution and other causes.

Second, there must be technical management information which includes those aspects of management which determine best use of an estuarine system from a scientific and technical standpoint. For example, it would be useless to manage an estuary for oyster production if the habitat in its natural state were not suitable for oysters. To resolve questions of best estuarine use, necessary information would include the following: size and shape; existing water quality; amount of water quality degradation; sources and types of wastes; climate, hydrology, circulation, ecology, present and potential habitat value; physical modification, bathymetry, and bottom conditions. The list of required management information, both institutional and technical, is organized into 14 Handbook of Descriptors sections. A brief description of each of these sections and the types of information they are designed to contain follows:

Section 1 identifies each estuarine subdivision according to its type, location in the United States, including States, counties, congressional districts, and the systems to which it is tributary.

Section 2 describes the physical structure of each estuarine subdivision; including its size, shape, total water area, area of marshland, climate, and any artificial circulation-modifying structures in the system.

Section 3 gives those areas which are owned by various political subdivisions, or which are zoned and under the control of special districts or management compacts; areas of parks and other recreation areas; and a list of the management compacts with particular interest in the estuarine zone.

Section 4 describes the hydrology of the estuarine system, including data on river flow and identification of major flow regulation structures.

Section 5 includes economic statistics on population, extent of urbanization, industrialization, commercial build-up, employment, etc.

Section 6 describes the oceanography of the area, including tidal regime, current patterns, and tidal prism.

Section 7 includes water quality information, listing extremes and variations and pertinent typical values in many water quality parameters.

Section 8 includes information on sedimentation and bottom characteristics of the area.

Section 9 describes the uses to which the area is put.

Section 10 describes sources of wastes, both municipal and industrial. It also includes a summary of the total amounts of waste and an individual listing of major waste discharges.

Section 11 includes statistics on use damages, both in terms of quantity of use lost and amount of monetary damage.

Section 12 included a list of immediate pollution abatement needs. FWPCA is now in process of developing a system of records maintenance on these needs and progress in meeting them so this section has been deleted from the Inventory until a later date.

Section 13 includes the water quality standards as presently approved for each State, and the acreages reserved for various beneficial uses as required by the standards.

Section 14 presents a list of past and current studies in the system identified by date, type of study, and the person or organization responsible.

Each of these major sections contain many individual parameters which were selected to attempt a full description of pertinent characteristics.

SELECTION OF DESCRIPTORS

Four criteria governed the selection of descriptors:

Availability

Although selected primarily on the basis of importance to management, where possible parameters reported on a national basis by a Federal agency were selected. Elsewhere, data in standard professional usage in the respective fields were used. Provision has been made to include additional types of data as the state-of-the-art advances.

Meaning

Each descriptor is a valid measure of some system characteristic needed for either technical or institutional estuarine management purposes.

Compatibility

Each descriptor is either directly informative or can be compared or combined with other descriptors to be meaningful. For example, except in extreme cases, tide range alone is not a useful management statistic; but in combination with the area of the estuary, it can help in determining flushing characteristics and overall ability of the system to rid itself of pollutants.

Uniqueness

Each descriptor is a fundamental datum; that is, it cannot be derived from other information included in the Inventory.

For two reasons, 1950 has been set as an arbitrary cut-off date for most historical data. First, water quality and waste discharge information, and many kinds of economic data extremely pertinent to the needs of this Study, were rarely collected before that date. Second, ecological and biological changes caused by estuarine alteration before that date would scarcely be discernible now, nor could their causes be traced.

SECTION 2. ESTUARINE REGISTER AREAS

As another means of organizing the pertinent information, a classification scheme for the estuarine areas of the United States was developed.

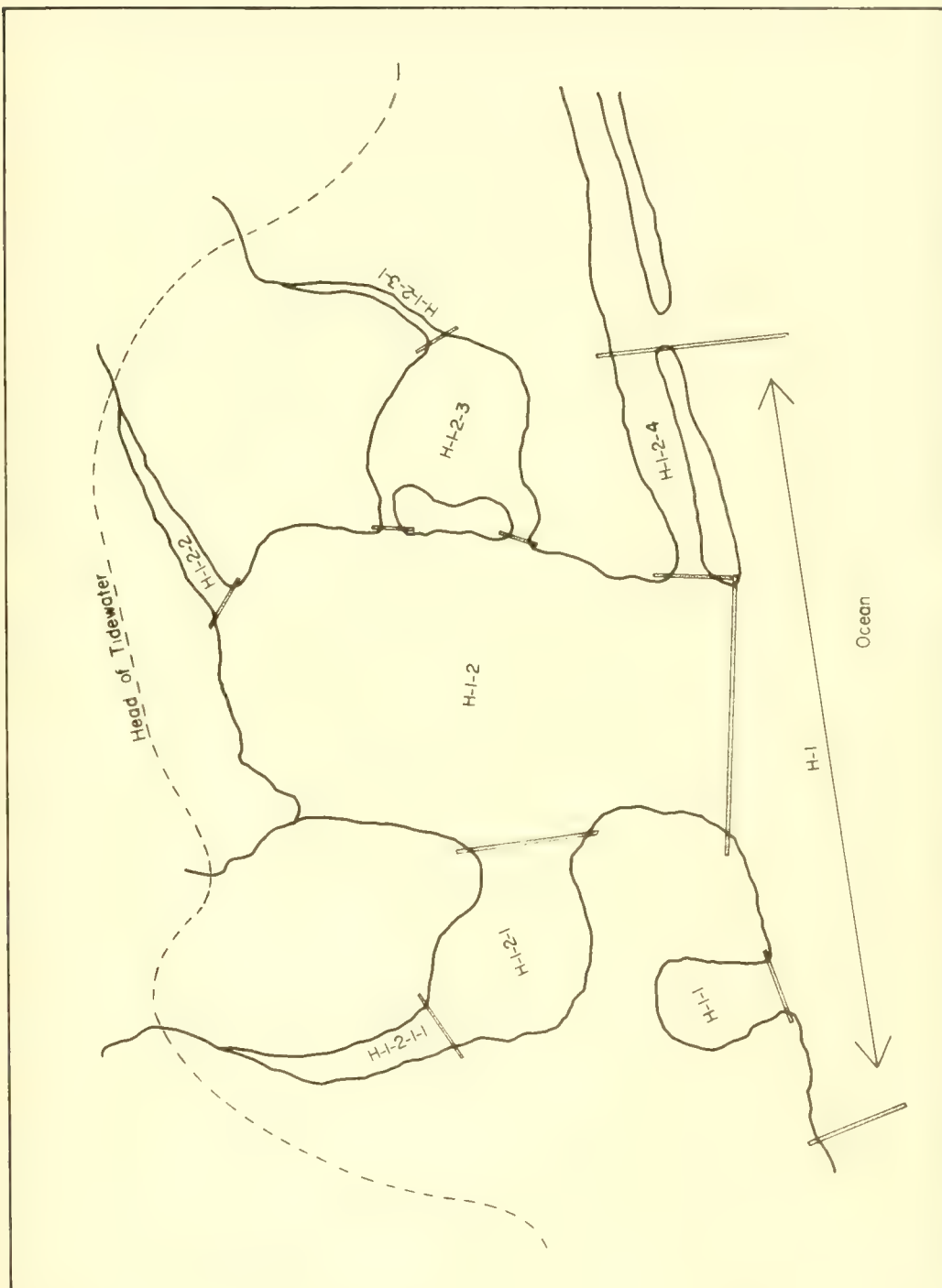
The entire coastline was divided into subdivisions called Estuarine Register Areas (ERA). (See Figure VI.1.2)

The object of this division and classification is to separate the coastal area into units within which information may be organized independently. The choice of boundaries for each system was based on consideration of its water pollution control and resource management aspects and does not necessarily reflect a scientific or engineering classification of estuarine systems.

Each coastal system tributary to, or composed partially of, an ocean or sea is designated a primary system. Estuaries tributary to a primary system are secondary systems; those tributary to secondary systems are tertiary systems; etc. This identification scheme includes all coastal waters of the United States, from the oceans to the limit of tidal effect. Although somewhat arbitrary, it offers a means of identifying areas without a cumbersome latitude and longitude arrangement and permits the addition of ERA's as needed.

As a further classification and identification of Estuarine Register Areas, a description classification scheme in terms of dominating

Figure VI12
SCHEMATIC OF ESTUARINE SYSTEM SHOWING SUBSYSTEMS



physical shape and configuration was developed (See Table VI.1.1 and Figure IV.4.23). Basically, the classifications range from a smooth shoreline to the deep indentation of a fjord. While not quantitative, this system is workable for the estuaries and estuarine zones of the United States.

TABLE VI.1.1
Morphological Classifications

<u>Type Number</u>	<u>Description</u>
1.1	Smooth shoreline without inlets.
1.2	Smooth shoreline with inlets.
1.3	Smooth shoreline with small embayments.
2.1	Indented shoreline without islands.
2.2	Indented shoreline with islands.
3.0	Marshy shoreline.
4.0	Unrestricted river entrance.
5.1	Embayment with Coastal Drainage.
5.2	Embayment with upland river flow.
6.0	Fjord.

SECTION 3. COLLECTION OF INFORMATION

The sources of information for the list of descriptors were many and varied. They include nearly all agencies of the Department of the Interior, many agencies of other Federal Departments, individual States, and private entities. Table VI.1.2. lists the primary sources of information for each major section of the Inventory. Note that the types of information obtained from each source are related directly to its operational missions.

In most cases, the information was obtained by direct request to the prime source agency. Where a compilation on a regional basis already existed this created no problems, however, in some cases, as with the U.S. Army Corps of Engineers and the Bureau of Sports Fisheries and Wildlife, it was necessary to compile some of the basic statistics. In most cases, the agencies were extremely cooperative in supplying the available information. In two cases, for the States of Alaska and Texas, contracts were negotiated to obtain Inventory data from widely scattered State files. Thousands of additional items, however, were obtained from a wide variety of other sources.

The operational missions of the Federal Water Pollution Control Administration make it the primary federal data source for information on water quality related to water pollution waste discharges and water quality standards in interstate waters. The major repository of interstate water pollution data, then, is the FWPCA regional offices. However, in all intrastate waters the States have primary

responsibility for water pollution problems. Thus, they are actually the primary source for the bulk of water quality and waste discharge information and in many cases it was necessary for the regional offices to work through the States for that information.

To provide information for in-depth case studies, a group of Estuarine Register Areas for which data were known to be available were chosen and designated Selected Estuarine Register Areas (SERA) (Table VI.1.3). With this designation went first priority for data collection. Information on these areas represents the most complete sections of the Inventory.

TABLE VI.1.1.2
Prime Data Sources - National Estuarine Inventory

<u>Inventory Section</u>	<u>Prime Source</u>
1. Identification	Federal Water Pollution Control Administration
2. Area Description	Bureau of Sport Fisheries and Wildlife U. S. Army Corps of Engineers Federal Water Pollution Control Administration
3. Managing Entities	Bureau of the Budget Department of Housing and Urban Development Bureau of Outdoor Recreation
4. Hydrology	U. S. Geological Survey
5. Stage of Development	Office of Business Economics
6. Physical Oceanography	U. S. Coast and Geodetic Survey
7. Water Quality	Federal Water Pollution Control Administration The States
8. Sediments and Sedimentation	U. S. Geological Survey

TABLE VI.1.2--Continued
Prime Data Sources - National Estuarine Inventory

9. Uses	U. S. Army Corps of Engineers U. S. Fish and Wildlife Service National Park Service Department of Defense U. S. Geological Survey Bureau of Mines
10. Sources of Pollution	Federal Water Pollution Control Administration The States
11. Use Damages	Bureau of Sport Fisheries and Wildlife Bureau of Commercial Fisheries U. S. Army Corps of Engineers U. S. Public Health Service
12. Immediate Pollution Control Needs	Federal Water Pollution Control Administration
13. Water Quality Standards	Federal Water Pollution Control Administration
14. Past and Current Studies	Federal Water Pollution Control Administration Bureau of Sport Fisheries and Wildlife The States

TABLE VI.1.3
Selected Estuarine Register Areas (SERA)
By Biophysical Region

North Atlantic

Penobscot Bay
Merrimack River-Ipswich Bay
Broad Sound (Boston Harbor)
Narragansett Bay

Middle Atlantic

Connecticut River
Hudson River
Raritan River
Delaware Bay
Pamlico Sound

Chesapeake Bay

James River
Potomac River
Patapsco River (Baltimore Harbor)
Patuxent River
Choptank River
Nanticoke River
Wicomico River

South Atlantic

Charleston, S.C. Coastal
Savannah Estuary
St. John's River

Carribean

Biscayne Bay Coastal

Pacific Islands

Kaneohe Bay

Gulf of Mexico

Tampa Bay
Apalachicola Bay
Mobile Bay
Biloxi Bay
Mississippi Delta
Barataria Bay
Atchafalaya Bay
Calcasieu Pass - Lake
Galveston Bay
Corpus Christi Bay

Pacific Southwest

San Francisco Coastal
Morro Bay
Newport Bay
San Diego Bay

Pacific Northwest

Humboldt Bay
Coos Bay
Yaquina Bay
Tillamook Bay
Columbia River
Willapa Bay
Grays Harbor
Bellingham-Anacortes
Hood Canal
Elliott Bay (Seattle Harbor)

Alaska

Gastineau Channel (Juneau)
Cook Inlet

SECTION 4. PRESENT STATUS OF THE INVENTORY

Presently, the Inventory consists of some 150 magnetic tapes of data containing more than 200 million individual pieces of information; several voluminous compilations of information not amenable to automation; hundreds of charts, maps, papers, books, and files; the complete coastline of the conterminous United States on microfilm; several thousand index cards containing a detailed bibliography; and considerable documentation ranging from step-by-step instructions for coding each column of each data card to multi-volume reports on sedimentation and ecology. It is unfortunate that the above represents complete and detailed information on no single estuary or estuarine zone in the United States. In a few cases only one or two crucial sections may be missing, but for the remainder there are large knowledge gaps which will be discussed in Chapter 2 of this Part. Overall, probably only about one-third to one-half of the existing pertinent information is stored in the Inventory data bank.

In compiling the mass of data mentioned above, pure research was found to be rare. The availability of data depends on there having been a sound economic reason for its collection. Among Federal or State agencies, for example, data is gathered as a matter of agency mission and is usually readily available; i.e., the Bureau of Census and the Office of Business Economics function as data-gatherers and can provide nationwide information as a matter of course.

Elsewhere, data may be collected for a single special purpose, such as a Corps of Engineers project study or an FWPCA technical assistance study. These usually result in a single report which may or may not include all the data gathered during the study, and which almost certainly would not be included in a nationwide compilation. In the last instance, each datum must be pulled from widely separated regional or district office files and arranged in a uniform manner to be useful on a broad scale.

A third large category of available data is that which is routinely gathered but is not routinely published. Included here are water pollution surveillance data, daily river flows, dredging statistics, and many, many others.

The routinely published information was, of course, the easiest to obtain. The decentralized report files were somewhat more difficult to acquire. Less significant because of the relatively small volumes of information involved, but most difficult to acquire, were the data from special surveys. In all cases, if required data are not in published reports, it is extremely difficult to locate and acquire them.

Of the published pertinent information, virtually all has either been included directly in the Inventory or has been summarized to be included in some form.

Several hundred thousand items from sources other than those mentioned above have also been entered.

As the process of collecting information developed, revisions in the descriptor list became necessary. In certain cases descriptors listed were not available on a basis broad enough to be useful, and an alternate descriptor which would provide the same type of information was substituted. In other cases no alternate descriptor could be selected. Table VI.1.4 lists these and contains comments on impact of their loss on management planning.

In summary, some data are available but have never been compiled; some data are available but will never be released; some data are available in massive quantities but have never been extracted; and other data have never been taken at all. Numerous examples of each kind were encountered. Where sufficient data were not available to describe an estuarine attribute adequately, alternative data were gathered and analyzed.

TABLE IV.1.4 MISSING DESCRIPTORS AND THEIR IMPACT

INVENTORY SECTION	DESCRIPTOR AND STATUS	IMPACT ON NEPS
Section 2 - Area Description	Fills (in most cases, only estimates by Bureau of Sport Fisheries and Wildlife and others, plus measurements of spoil areas from Coast & Geodetic Survey charts, are available)	Alteration is not necessarily synonymous with destruction. Exact fill data on a variety of types of estuarine systems would allow evaluation of the destructive or constructive values of various schemes for filling.
Section 3 - Managing Entities	Legally owned facilities and reserved zones (not generally available below federal level)	A comprehensive management plan for a single estuary or for the complete national coastline must consider all the existing management entities. Without this data the minute specifics of a management plan are impossible to delineate.
Section 3 - Zoning or Regional Development	Zoning or regional development (the names of responsible groups are available, however, little information relating to actual estuarine planning has been located.)	A national plan should not conflict with a workable regional, state or local plan. Fuller knowledge of existing planning organizations could allow fuller federal/state/local cooperation through existing groups (whether currently engaged in estuarine planning or not) without the necessity of establishing another level in the hierarchy.
Section 6 - Physical Oceanography	Currents and current speeds	These are the major indicators of rates of flushing of pollutants.
Section 8 - Sediments and Sedimentation	Sediment quantities and characteristics (with the exception of a few case studies almost no information is available).	Through fuller knowledge of sediment amounts and their effects, specific and positive actions could be suggested to alleviate many problems by existing interested entities; i.e., the Soil Conservation Service, the U. S. Army Corps of Engineers, etc.

SECTION 5. PROBLEMS AND SOLUTIONS

Because no section in the Inventory contains all of the data deemed necessary, there follows a brief discussion of each Inventory section in which major problems were encountered and the measures taken to overcome them. The results of these actions are reflected primarily in this report and not in the data entries of the Inventory.

Handbook Section 2. Area Description

Problem: Many of the necessary data are implicit on available maps and charts, but very few measurements of estuaries and their associated marshes and tidelands have ever been extracted or organized. Not even the U. S. Army Corps of Engineers which performs, or issues permits for, most of the dredging in the Nation, was able to provide information on spoil areas and fills therein. No consistent data were available on landfills of any kind, whether industrial, residential, or sanitary.

Solution: Using U. S. Coast and Geodetic Survey navigation charts and a 1940 U. S. Coast and Geodetic Survey of tidal shoreline measurements, the areas of many estuaries, marshes, and spoil areas have been hand measured and compiled. Many fills and spoil areas have also been

estimated by the Bureau of Sport Fisheries and Wildlife who stress that most of these data are only estimates, not measurements. Their consistency, however, constitutes best-source information and as such they are included in the Inventory.

Handbook Section 3. Managing Entities

Problem: Legal ownership at the federal level is available information; but state and local ownership, as well as zoning information, is practically unobtainable at other than the level of the responsible organizations, generally municipality or county. Some special study information on specific areas constitutes most of the available data.

Solution: Based on material gathered through the Department of Housing and Urban Development and the Bureau of the Budget, as well as several public and private reports and documents, it was possible to identify almost 200 federal, interstate, state-federal, county, and sub or multi-county planning groups who receive federal monies and may have concern in the estuarine zone. This must be regarded only as a step in the right direction.

Handbook Section 5. Stage of Development

Problem: Some pertinent statistics on economic development were found to be available at no lower level than by State. A number of statistics, shown as available in the Departments of Agriculture and Commerce census catalogs,

were added to the descriptors in hopes of alleviating the problem. However, examinations of the computer printouts of both groups showed significantly incomplete or erratic inclusions of information.

Solution: Attack from all available angles. Some data are included from the United States Department of Agriculture, the Office of Business Economics, reports contained in the "Statistical Abstract of the United States," and still other information came from special reports on specific areas. This section is still not satisfactorily complete particularly for Alaska and Hawaii since data on these States is not included on current data tapes procured from the Departments of Agriculture and Commerce.

Handbook Section 6. Physical Oceanography

Problem: Tidal information for the entire coastline is fairly complete, but actual measurements of currents and current speeds are sparse. Some information is available on major ports and areas where special studies have been made.

Solution: Since the data have never been taken, this problem has no present solution.

Handbook Section 7. Water Quality

Problem: Because there apparently have been no consistent monitoring programs carried out on the federal or state level, most of the available data is only for those areas which have serious habitat or pollution problems.

Solutions: Those areas which lack water quality data were compared with available "Stage of Development" data. There is a strong correlation between lack of data and lack of population pressures. While demographic information is no substitute for water quality data, it does at least serve as an indicator of potential problem areas.

Handbook Section 8. Sediments and Sedimentation

Problem: Sampling of estuarine sediments has apparently been done principally as a part of a specific U. S. Army Corps of Engineers project investigation or as part of a research project. The majority of this sampling has been limited to surface samples of the bottom, with only occasional core samples. U. S. Army Corps of Engineers navigation channel data is, of course, the best source, but is still extremely limited.

Solution: Although little concrete data exists, much has been written on the subject. Two contracts were let with

U.S. Geological Survey to investigate the literature and additional contracts were let to perform sediment case studies in estuaries of various types.

Handbook Section 9. Uses

Problem: While commercial use data are generally available, recreational use is not so easily documented. Only in areas where intensive studies have been made are these concrete data on participation days, boat use, swimming, sports fishing, etc. The same is true of use by fish and wildlife.

Solution: Examination of related data--fishing and hunting license sales, the results of creel surveys, the number of marinas and boat slips--permitted extrapolation wherever feasible. Many of the data included in this area are estimates by the field staff of the Bureau of Sports Fisheries and Wildlife and State commercial and sports fishing agencies.

Handbook Section 10. Sources of Pollution

Problem: While the locations of most of the major waste discharges are known, information on the characteristics of individual waste effluents is extremely limited. They are known accurately only for the largest municipal waste discharges and for waste discharges in areas which have been the subject of an enforcement or technical assistance study. In particular, knowledge of the characteristics of individual industrial waste discharges is very poor, and data on them are extremely scattered. This is also true of other waste discharges,

such as agricultural land drainage, waste from recreational facilities, and the specific effects of watercraft wastes in estuaries.

Solution: The principal waste characteristics of each major type of industry with locations in the coastal zone were defined, then combined with known water use by various of these existing industries, where the processes and types of treatment are known. The results of such combinations are very general at best and have been automated in the Inventory only where actual measurements were encountered.

Handbook Section 11. Use Damages

Problem: Concrete use damages information is very rare. Although the citizen can easily see and smell the results of pollution in many areas, documentary proof is another matter. Only in cases which have been the subject of an enforcement action of one kind or another, has there been any real effort to prove a damage to use. Even then, it has been much easier to get information on commercial damages than on those recreational or aesthetic use.

Damage to a species not of commercial or sports value is almost impossible to document, although it may be critical to the food chain. Most of the remaining information is subjective estimation, by local residents or political entities, which provide coverage limited by the intensity of local interest in estuary

or estuarine zone. Unfortunately, it appears that many of these estimates were chosen for dramatic effort, rather than as an actual indication of damage caused.

Solution: An effort has been made to eliminate the wild estimate and to enter only actual measurements. Data considered when making such an estimate would include such items as declining water quality, decrease of pollution-sensitive species and increase of pollution-tolerant species, closed shellfish beds, etc.

Handbook Section 13. Water Quality Standards

Problem: The water quality standards information for the entire coastline is complete, but the various States use different bases for classifying their waters and reserving them for particular uses. The categories of use sometimes do not fit overtly with those shown in the Act which set up the water quality standards procedures. Also, the standards frequently refer to an entire water area or to a part of an area with such vagueness that obtaining an idea of actual acreage included is impossible.

Solution: The uses which are allowed were often available and have been entered in the Inventory. The rest of the problem does not appear amenable to solution at this time.

It is apparent that while there is a wide variety of information on the estuaries of the United States, there are some very large gaps

from a management standpoint. Much water quality, waste discharge, ecological, and habitat information is simply not available because there has been no consistent program of monitoring or collecting basic data in the estuarine zone. Economic data are available down to the county level for most commercial enterprises, but quantitative information in terms of recreation and aesthetic values is sadly lacking. While the resources available to this Study have not permitted a thoroughly exhaustive compilation of data (with the exception of a few areas), the very large amount of material compiled does show where the significant gaps in information are. These gaps are such as to severely limit adequate analysis of quantifiable values in estuaries as a national entity except for commercially and economically reported uses. Some solutions to this problem will be discussed in Chapter 2 of this Part.

SECTION 6. AUTOMATION OF THE INVENTORY

The products of an inventory are neat, well-organized tables, and lists containing the information required in the subject area. The National Estuarine Inventory, then, required a technique which could be used to store, retrieve, and manipulate a wide variety of information types to describe the dynamic conditions of the Nation's 884 ERA's. The two prerequisites were huge capacity and great flexibility. To satisfy these needs, all Inventory data amenable to the technique are automated.

All of the automated information has been placed on magnetic tape, including both numeric and narrative information. Retrieval is possible either by Estuarine Register Area number (Table VI.1.5) or by the individual descriptor itself (Table VI.1.6), making it possible to call for any combination of descriptors for any combination of Estuarine Register Areas.

Programming was also developed to secure printouts in a finished format so that if necessary, printout from the Inventory could be photographed directly for inclusion in a report as a table (TABLE VI.1.7) or as computerized plots (Figures VI.1.3 and VI.1.4). Most of the tables in this report were prepared in this fashion (TABLE VI.1.8). The capability for storing narrative information also increases the system's usefulness as a repository for management information.

Although much qualitative information is automated in the Inventory,

some such information is not amenable to automation, or is less expensive to compile by other methods into an equally useful form. Specifics on current institutional arrangements and broad scale descriptive materials are examples.

Access to the available information will be open to all Federal, State, and local agencies through FWPCA.

TABLE VI.1.5

EXAMPLE OF A PARTIAL ERA RETRIEVAL

NOTES:

- (1) The following five pages are from the Inventory's master file summary tapes. The shortened titles and coded entries shown are used in the master only. Full titles and code translations will be used in regional, state, or local level retrievals.
- (2) The ERA presented, Eel River, California, is neither the most, nor the least complete. It is fairly typical of the smaller ERA's.
- (3) In addition to the ERA level data shown, other files contain information on the land areas adjacent to the Eel River. These include populations, employment statistics, industrial locations, etc., as well as off-shore oceanographic and fisheries data.
- (4) The pages shown were chosen to illustrate the manner of organization rather than to provide data.
- (5) The information contained in the Inventory files is that gathered to provide quantitative information for the National Estuarine Pollution Study.

TABLE VI.1.5. (Cont'd)

NATIONAL ESTUARINE PROGRAM REPORT AS OF 10-31-69

EPA NUMBER 8-00-01-000 FEL RIVER NAME
15W-31-4 8-00-01-000 FEL RIVER NAME
FEL RIVER, 10 MILES NORTHWEST OF FALSE CAPE.
THIS IS A STREAM OF CONSIDERABLE SIZE AND IS OCCASIONALLY
ENTERED BY LIGHT-DRAFT VESSELS, BUT THE CHANNEL OVER THE
BAR IS CONTINUALLY SHIFTING. THE DEPTH IN THE BAR VARIES
LARGELY WITH THE AMOUNT OF WATER IN THE RIVER, DEPENDING
UPON THE CHARACTER OF THE WINTER. THERE HAS BEEN AT TIMES AS
MUCH AS 14 FEET, BUT GENERALLY THE DEPTH IS ABOUT 8 OR 9
FEET. THE RIVER IS SELDOM ENTERED EXCEPT BY FISHING BOATS
AND OTHER VERY SMALL CRAFT, AND THE RIVER IS USED BY THOSE WITH
LOCAL KNOWLEDGE OF THE BAR.
FEL CANYON IS A CANYON VALLEY EXTENDING IN A NORTH-
WESTERLY DIRECTION. IT COMES TO A HEAD 15 MILES NORTH-
WESTWARD OF CAPE MENOMINCING. VESSELS ARE CAUTIONED AGAINST
MISTAKING THIS VALLEY FOR ONE OF THE BAY NORTHWARD OF THE
CAPE.

RECEIVING SYSTEM #1 #2 #3 #4 #5 #6

HUMPHREY, CALIF. PACIFIC OCEAN

NATIONAL STATE COUNTY AND CONGRESSIONAL DISTRICTS

01-04 03 1

ENTIRE LENGTH 20-1-1 TOTAL LENGTH NAV-ON-RTY REG-APPEAS SUR-SYS ISLANDS 1-1-1 MAX-LENGTH MAX-WIDTH SHORFLINE-LENGTH

20-1-1 20-1-1 20-1-1 20-1-1 20-1-1 20-1-1

MMH/MHRA 2- 1850 MARSH 2- 1/10 TOTAL WATER AND WETLANDS AREA 5/80 6/100 7 8 9

RIVER, CALIF. 11,477,000 TOTAL AREA GAGED BY WATER GAUGES 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

MEAN 5709 4935 7227 11862 5937 3099 7322 1873 10707 4999 3550 1145 9908 4494 10869 6130 2493 4658

MINIMUM 75 75 104 102 90 50 63 40 63 60 60 12 20 35 48 52 42 42

MAXIMUM 116000 137000 111000 231000 218000 53600 108000 52000 138000 100000 69200 62900 121000 141000 179000 166000 37100 18100

TABLE VI.1.5. (Cont'd)

FRA NUMBER 15W-03-03-00-00-00 FFL RIVER	NAME	LAT---LONG 040378 124193	TOTAL AREA	GAGED AREA	GAGE NR	FL 14 OF RIVERS WATER YEAR	LAT---LONG 000000 000000	DESC UNRESTRICTED RIV ENTRANCE
PIVOT NAME							MINIMUM	MAXIMUM
VAN DUZEN	11,478,00	216	31	2082	32	64600		
			32	4729	34	123000		
			33	4811	43	53600		
			34	3330	52	44500		
			35	6841	53	77300		
			36	7816	67	182000		
			37	4862	60	95300		
			38	14891	85	316000		
			39	3582	42	96500		
			40	9949	42	261000		
			41	11238	97	124000		
			42	10177	105	184000		
			43	7672	100	208000		
			44	2958	55	43400		
			45	6502	67	86400		
			46	8093	50	186000		
			47	3477	47	62500		
			48	6352	47	91600		
			49	5584	42	115000		
			50	5578	38	105000		
			51	9691	80	199000		
			52	10808	85	188000		
			53	9533	76	158000		
			54	9394	144	213000		
			55	4163	102	40000		
			56	13772	82	433000		
			57	5843	82	130000		
			58	84030		2290000		
			59	27835		1970000		
			60	42870		5380000		
			61	7275		94800	95	
			62	5335		81900	96	
			63	9643		212000	128	
			64	4587		122000	67	
			65	12628		648000	67	
			66	1011		44500	6	
			67	1033		16100	8	
			68	991		16100	8	
			69	1020		21400	11	
			70	497		11600	8	
			71	1360		30300	9	
			72	685		15900	8	
			73	1422		15600	13	
			74	688		18300	6	
			75	653		20500	8	
			76	819		11900	8	
			77	589		7550	8	
			78	1073		12400	11	

TABLE VI.1.5. (Cont'd)

PAGE NUMBER 8377

NATIONAL ESTUARINE INVENTORY LIPPT AS OF 10-31-69

NAME	LAT---LONG	LAT---LONG	DESC
FRANJIMASTER	040378 124193	000000 000000	UNRESTRICTED RIV ENTRANCE

DIVISION NAME	GAGE #	TOTAL AREA	GAGED AREA	PERCENT OF DIVISION	MEAN	MINIMUM	MAXIMUM
AREA 1	1147916	127		64	628	8	21700
				65	1085	7	33900
				54	418	6	6330
				55	288	6	7730
				47	370	4	6310
AREA 2				63	622	5	8720
				53	324	5	7750
				50	263	5	7810

[illegible]

PARAMETER	UNIT	YEAR	ANNUAL VARIATION	WATER QUALITY	DEPTH	MINIMUM	MEAN	MAXIMUM	TEMPERATURE (TURBIDITY) (DISSOLVED OXYGEN) (PH) (NITRATE) (PHOSPHATE) (CHLORIDE) (CALIFORNIA)
1	°N	33	66	132.10	0000	4000	4300	4800	
2	°E	33	66	132.40	0000		4100	4700	
3	°N	34	66	132.10	0000		1370	1400	
4	°E	34	66	132.40	0000	96	1330	1400	
5	°N	35	66	132.10	0000	91	1330	1400	
6	°E	35	66	132.40	0000	20	6	150	
7	°N	36	66	132.10	0000	20	6	14	
8	°E	36	66	132.40	0000	1	440	1400	
9	°N	37	66	132.10	0000	140	1330	1400	
10	°E	37	66	132.40	0000	22	713	1400	

PARAMETER	UNIT	INLET	OUTLET	DISCHARGE	DATE	WATER QUALITY	WATER	TEMPERATURE	DEPTH	LEFT SIDE	RIGHT SIDE	BIOCHEMICAL OXYGEN DEMAND
0.30-31.0	14	2	01-17-69	04-33-41	174-337			44				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			76				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			44				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			74				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			132				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			74				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			211				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			9				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			24				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			212				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			16				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			109				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			25				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			60				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			68				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			2005				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			44				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			35				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			25				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			54				
0.30-31.0	14	2	01-17-69	04-33-41	174-337			83				

TABLE VI.1.5. (Cont'd)

PAGE NUMBER 8379

NATIONAL ESTUARINE INVENTORY REPORT AS OF 10-31-69

ERA NUMBER NAME
15W-03-03-00-00-00 FFL RIVER

IMPORTS DOMESTIC NR. COMMERCIAL SHIPPING
EXPORTS TRAFFIC SHIPS

YEAR LICENCES DUCK STAMPS HUNTING
65 COST \$1200 20 2- 2- 5000

YEAR NO-SEAPLANES NR-APPROACHES MP-AIRPORTS NR-EXPANSION
65

TYPE YEAR FISHING CATCH POUNDS FISHING NR. NR. BOATS TOTAL PI3 BEACHES USACE ACCESS PUBLIC MOORING BOATING FISHING ANNUAL COST
63 30 000002304

TYPE YEAR STATUS QUANTITY UNIT SPENT AND COMMERCIAL FISHING LOST
999 65 00 2- 02 SEE SHEET 31

TYPE YEAR FEDERAL STATE MANAGED AREAS LOCAL PRIVATE CAUGHT NUMBER CURRENT HABITAT LOST
701 68 1600
702 68 3-
703 69 3-
801 69 3-
802 69 3-
803 69 3-

WASTE OR TREATED EFFLUENT DISCHARGE CHARACTERISTICS
TREATMENT LOCATION SIC SPEC-PROPS
04 000002 000002
1 2 3 LAT LONG CODE 1 2 3 PARA UNIT INFLUENT EFFLUENT
032001 25 2- 3
000310 18 2- 6090
032001 25 2- 3
000310 18 2- 2040

**TABLE VI.1.6 RETRIEVAL OF AN INDIVIDUAL DESCRIPTOR,
NATIONAL ESTUARINE INVENTORY**

COASTAL ZONE FARM ACTIVITY *					
BY BIO-REGION					
BY ESTUARINE PORTION OF STATES					
BIO-REGION	STATE	NUMBER OF FARMS	ACREAGE OF FARMS 1000 AC.	PERCENT OF ALL LAND	VALUE-FARM PRODUCTS \$1000
NORTH ATLANTIC	MAINE	5,087	842	21.6	60,706
	NEW HAMPSHIRE	1,115	153	22.7	12,191
	MASSACHUSETTS	3,149	263	10.7	54,877
	TOTAL	9,351	1,258	18.3	127,774
MIDDLE ATLANTIC	MASSACHUSETTS	778	58	16.2	13,897
	RHODE ISLAND	1,100	105	17.9	18,537
	CONNECTICUT	2,546	254	17.0	46,513
	NEW YORK	1,768	104	4.5	64,763
	NEW JERSEY	7,019	675	17.1	150,774
	PENNSYLVANIA	3,914	393	26.4	65,240
	DELAWARE	4,401	717	54.8	107,631
	VIRGINIA	**	**	**	6,339
	MARYLAND	824	140	45.2	25,742
	NORTH CAROLINA	7,768	1,014	38.6	77,647
	TOTAL	30,118	3,460	23.8	577,143
CHESAPEAKE BAY	VIRGINIA	7,765	1,388	32.6	59,812
	MARYLAND	12,532	1,986	51.5	169,185
	TOTAL	20,297	3,374	42.1	228,997
SOUTH ATLANTIC	NORTH CAROLINA	11,441	1,255	27.5	113,292
	SOUTH CAROLINA	10,003	1,367	30.6	54,666
	GEORGIA	721	295	15.9	3,867
	FLORIDA	4,106	2,102	42.6	222,066
	TOTAL	26,271	5,019	29.2	393,891
CARRIBEAN	FLORIDA	1,511	498	11.7	76,326
	PUERTO RICO	***	***	***	***
	VIRGIN ISLANDS	***	***	***	***
	TOTAL	***	***	***	***
GULF OF MEXICO	FLORIDA	10,620	3,472	34.8	122,743
	ALABAMA	3,336	544	29.6	27,833
	MISSISSIPPI	1,527	167	15.0	2,959
	LOUISIANA	9,217	2,267	26.2	90,633
	TEXAS	13,367	8,675	82.1	229,068
	TOTAL	38,067	15,125	37.5	473,236
PACIFIC SOUTHWEST	CALIFORNIA	26,772	9,753	48.1	1,002,313
	TOTAL	26,772	9,753	48.1	1,002,313
PACIFIC NORTHWEST	CALIFORNIA	1,270	823	20.0	17,281
	OREGON	12,377	1,839	18.5	78,476
	WASHINGTON	19,458	1,461	15.5	144,850
	TOTAL	33,105	4,123	18.0	240,607
PACIFIC ISLANDS	HAWAII	6,242	2,354	64.7	187,557
	GUAM	***	***	***	***
	AMERICAN SAMOA	***	***	***	***
	TOTAL	***	***	***	***
ALASKA	ALASKA [ALL]	382	1,959	0.6	3,771
		382	1,959	0.6	3,771

* USDA RECORDS-1967

** NEGLIGIBLE

*** INFORMATION NOT AVAILABLE

TABLE VI.1.6 RETRIEVAL OF AN INDIVIDUAL DESCRIPTOR,
NATIONAL ESTUARINE INVENTORY (continued)

STATE	BOAT REGISTRATION BY STATE [1967] ** [COASTAL ONLY]	LICENSING CRITERIA	INBOARD AND OUTBOARD TOTAL - 65: AND LESS	
ALABAMA	ALL MOTORBOATS, SAILBOATS		95,620	
ALASKA *	MORE THAN 10 HP.		14,284	
CALIFORNIA	ALL MOTORBOATS, SAILBOATS OVER 8:		345,441	
CONNECTICUT	MORE THAN 5 HP.		64,646	
DELAWARE	ALL MOTORBOATS		12,003	
D.COLUMBIA *	MORE THAN 10 HP.		2,989	
FLORIDA	10 HP. OR MORE		175,757	
GEORGIA	MORE THAN 10 HP.		82,085	
HAWAII	ALL MOTORBOATS, SAILBOATS OVER 8:		6,024	
LOUISIANA	MORE THAN 10 HP.		73,711	
MAINE	MORE THAN 10 HP.		34,249	
MARYLAND	MORE THAN 7.5 HP.		65,692	
MASSACHUSETTS	5 HP. OR MORE		90,481	
MISSISSIPPI	MORE THAN 10 HP.		17,585	
NEW HAMPSHIRE *	MORE THAN 10 HP.		5,259	
NEW JERSEY	ALL MOTORBOATS		127,734	
NEW YORK	ALL MOTORBOATS		391,207	
NORTH CAROLINA	MORE THAN 10 HP.		81,348	
OREGON	MORE THAN 3.5 HP., SAILBOATS 12: UP		71,560	
PENNSYLVANIA	ALL MOTORBOATS		108,042	
RHODE ISLAND	ALL MOTORBOATS		10,412	
SOUTH CAROLINA	10 HP. OR MORE		59,858	
TEXAS	MORE THAN 10 HP. & ALL MOTORBOATS OVER 14:		207,125	
VIRGINIA	10 HP. OR MORE		58,174	
WASHINGTON	MORE THAN 10 HP.		86,775	
GUAM *	MORE THAN 10 HP.		215	
PUERTO RICO	ALL MOTORBOATS		1,834	
VIRGIN ISLANDS	ALL MOTORBOATS		1,901	

* NO COAST GUARD BOAT NUMBERING AS OF 12/31/67

** COURTESY BOATING IND.ASSOC., OUTDOOR BOATING CLUB, & USCG

TABLE VI.1.7 SAMPLE TABLE OF NATIONAL ESTUARINE INVENTORY PRINTOUT

MID-MONTH LENGTH OF DAY AT SELECT COASTAL STATIONS

STATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PORTLAND, MAINE	9.30	10.52	11.88	13.42	14.72	15.42	15.13	14.00	12.53	11.05	9.68	8.95
ROSTON, MASS	9.43	10.58	11.88	13.37	14.60	15.27	14.98	13.92	12.50	11.10	9.80	9.10
NANTUCKET, MASS	9.53	10.65	11.90	13.52	14.50	15.13	14.87	13.85	12.50	11.13	9.88	9.22
BRIDGEPORT, CONN	9.53	10.63	11.90	13.30	14.48	15.13	14.87	13.83	12.48	11.13	9.90	9.23
RLOCK ISLAND, R.I.	9.58	10.68	11.90	13.30	14.48	15.13	14.87	13.85	12.50	11.13	9.90	9.22
LA GUARDIA, NEW YORK	9.70	10.73	11.92	13.28	14.35	15.08	14.82	13.80	12.50	11.15	9.92	9.28
ATLANTIC CITY, N.J.	9.72	10.75	11.90	13.23	14.33	15.03	14.68	13.73	12.47	11.20	10.03	9.42
HALTMOORE, MARYLAND	10.03	10.92	11.95	13.08	14.02	14.52	14.67	13.72	12.47	11.20	10.03	9.43
CAPE HATTERAS, N.C.	10.12	10.97	11.95	13.03	13.93	14.43	14.22	13.45	12.42	11.32	10.32	9.80
WILMINGTON, N.C.	10.12	10.97	11.95	13.03	13.93	14.43	14.22	13.45	12.42	11.32	10.32	9.80
CHARLESTON, S.C.	10.28	11.02	11.97	12.97	13.80	14.25	14.12	13.38	12.40	11.38	10.48	9.88
SAVANNAH, GEORGIA	10.28	11.02	11.97	12.97	13.80	14.25	14.12	13.38	12.40	11.38	10.48	9.88
JACKSONVILLE, FLA.	10.40	11.13	11.97	12.90	13.68	14.10	13.93	13.27	12.35	11.45	10.63	10.20
DAYTONA, FLA.	10.48	11.18	11.97	12.87	13.62	14.00	13.83	13.20	12.35	11.48	10.70	10.28
WEST PALM BEACH, FLA.	10.63	11.27	11.98	12.78	13.52	13.82	13.67	13.08	12.32	11.53	10.83	10.48
MIAMI, FLORIDA	10.70	11.30	12.00	12.77	13.40	13.75	13.60	13.05	12.32	11.57	10.90	10.53
FORT MYERS, FLA.	10.67	11.27	11.98	12.78	13.45	13.80	13.65	13.08	12.32	11.55	10.83	10.48
TAMPA, FLORIDA	10.57	11.22	11.98	12.82	13.53	13.92	13.75	13.15	12.33	11.52	10.77	10.38
APALACHICOLA, FLA.	10.45	11.15	11.97	12.88	13.55	14.05	13.88	13.23	12.37	11.48	10.67	10.25
PENSACOLA, FLA.	10.38	11.12	11.97	12.90	13.68	14.10	13.92	13.27	12.37	11.45	10.63	10.20
MOBILE, ALABAMA	10.38	11.12	11.97	12.90	13.68	14.10	13.92	13.27	12.37	11.45	10.63	10.20
PUERTO RICO & VIRGIN IS	11.15	11.55	12.02	12.55	13.00	13.23	13.13	12.75	12.25	11.73	11.28	11.03
NEW ORLEANS, LA.	10.43	11.15	11.95	12.88	13.65	14.07	13.90	13.25	12.35	11.47	10.65	10.23
LAKE CHARLES, LA.	10.42	11.13	11.97	12.90	13.67	14.10	13.92	13.25	12.35	11.47	10.63	10.22
GALVESTON, TEXAS	10.47	11.17	11.97	12.87	13.62	14.02	13.83	13.22	12.35	11.48	10.70	10.28
CORPUS CHRISTI, TEXAS	10.58	11.23	11.97	12.83	13.52	13.90	13.75	13.13	12.33	11.52	10.78	10.40
BROWNSVILLE, TEXAS	10.70	11.30	11.98	12.77	13.40	13.75	13.60	13.07	12.32	11.57	10.88	10.53
SAN DIEGO, CALIFORNIA	10.23	11.03	11.95	13.00	13.83	14.50	14.12	13.37	12.38	11.38	10.48	10.02
SANTA MARIA, CALIFORNIA	10.08	10.95	11.93	13.07	13.98	14.50	14.28	13.47	12.42	11.33	10.35	9.83
SAN FRANCISCO, CALIF.	9.85	10.82	11.93	13.17	14.20	14.77	14.53	13.63	12.45	11.25	10.15	9.57
FURENA, CALIFORNIA	9.58	10.67	11.90	13.30	14.40	15.10	14.82	13.82	12.48	11.15	9.93	9.27
HONOLULU, HAWAII	10.98	11.47	12.02	12.63	13.15	13.43	13.32	12.82	12.27	11.67	11.12	10.83
HILO, HAWAII	11.07	11.52	12.02	12.63	13.15	13.43	13.32	12.82	12.25	11.70	11.20	10.95
ASTORIA, OREGON	9.03	10.37	11.87	13.53	14.97	15.72	15.42	14.18	12.57	10.97	9.47	8.65
SEATTLE - TACOMA, WASH	8.88	10.30	11.85	13.62	15.10	15.95	15.58	14.27	12.60	10.92	9.33	8.48
ANETTE, ALASKA	7.80	9.73	11.80	14.12	16.15	17.35	16.82	15.00	12.77	10.55	8.42	7.22
JUNEAU, ALASKA	7.13	9.40	11.77	14.40	16.78	18.25	17.60	15.43	12.85	10.32	7.87	6.42
YAKUTAT, ALASKA	6.85	9.27	11.75	14.52	17.03	18.53	17.93	15.58	12.88	10.23	7.63	6.08
ANCHORAGE, ALASKA	6.42	9.07	11.73	14.70	17.45	19.48	18.97	15.85	12.95	10.12	7.30	5.53
COLD BAY, ALASKA	7.75	9.72	11.82	14.30	16.18	17.58	16.85	15.02	12.75	10.52	8.38	7.17
ST. PAUL, ALASKA	7.38	9.52	11.78	14.30	16.53	17.88	17.28	15.25	12.82	10.40	8.07	6.73
KING SALMON, ALASKA	7.05	9.37	11.77	14.45	16.85	18.37	17.68	15.47	12.87	10.30	7.80	6.32
BARRUW, ALASKA	0.0	6.97	11.55	16.53	24.00	24.00	24.00	19.70	13.50	8.83	2.58	0.0
BARTER ISLAND, ALASKA	0.0	7.32	11.58	16.20	24.00	24.00	24.00	18.28	13.42	9.05	3.73	0.0

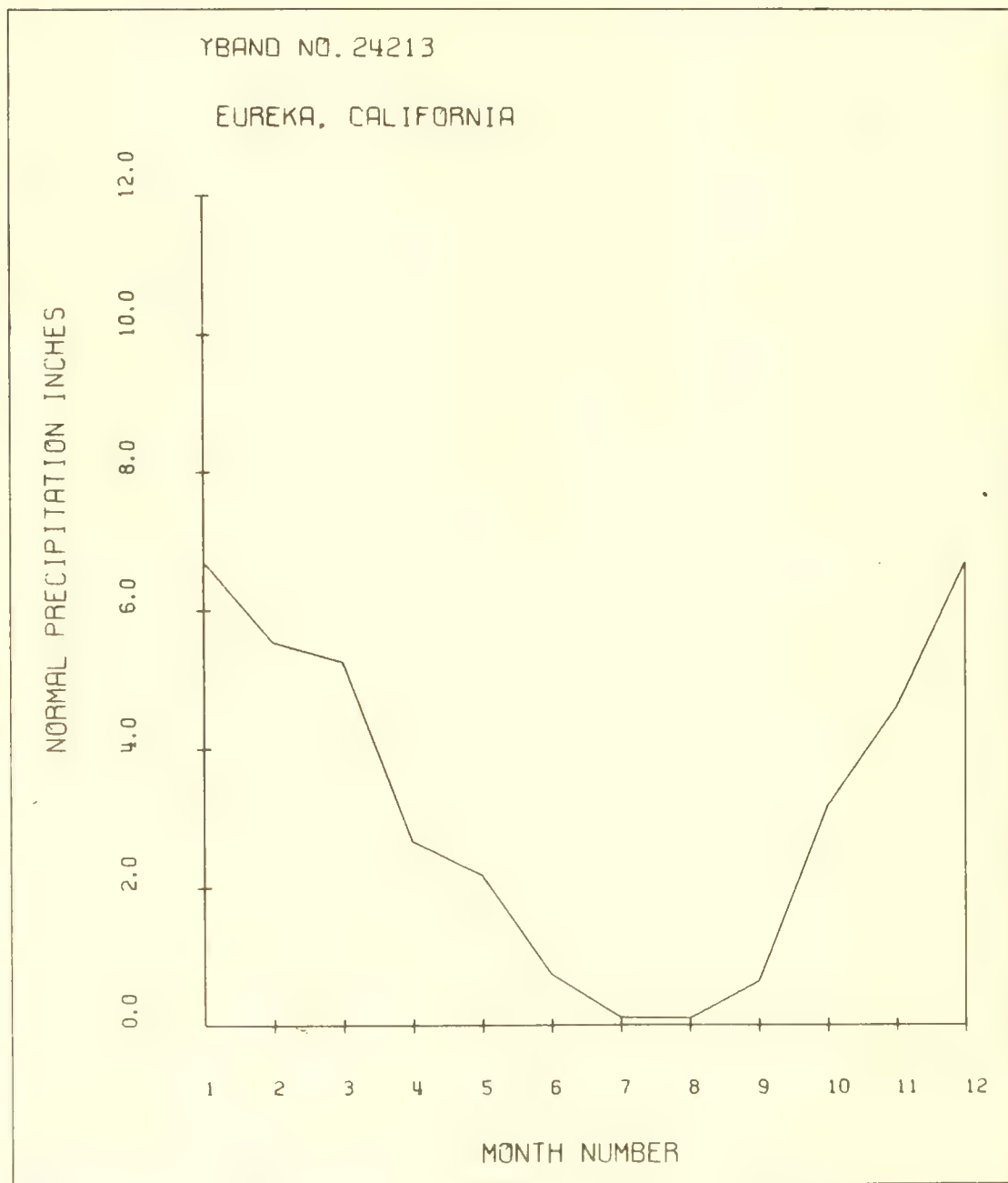
FIGURE VI.1.3 A DETAIL PLOT FROM THE NATIONAL
ESTUARINE INVENTORY

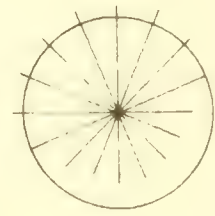
FIGURE VI.1.4
EXAMPLE OF SUMMARY DATA AND PLOTS (HILO, HAWAII)

Temperature				Precipitation				Relative humidity				Wind				Mean number of days			
Normal		Extremes		Normal		Year		Snow, Sleet		Standard time used		Speed		Prevailing direction		Sunrise to sunset		Thunderstorms	
Daily maximum	Daily minimum	Month	Year	Record highest	Record lowest	Year	Year	Maximum	Minimum	AM	PM	Speed	Direction	Year	Year	Clear	Partly cloudy	Cloudy	Precipitation 0.1 inch or more
(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	(q)	(r)	(s)	(t)
J 78.7	62.8	70.8	89	1967+	55	1961	11.82	29.11	1946	0.36	1953	9.94	1946	0.0	0.0	0.0	0.0	0.0	0.0
F 78.6	62.6	70.6	88	1947	53	1962	12.94	39.32	1956	1.70	1963	13.41	1944	0.0	0.0	0.0	0.0	0.0	0.0
M 78.2	63.0	70.6	88	1967+	55	1969	16.70	31.91	1948	2.97	1944	9.18	1953	0.0	0.0	0.0	0.0	0.0	0.0
M 78.9	64.3	71.6	89	1963	56	1969	11.92	31.94	1963	2.93	1962	9.39	1954	0.0	0.0	0.0	0.0	0.0	0.0
A 80.4	65.6	73.0	94	1966	58	1947	9.33	25.01	1964	1.18	1945	10.26	1955	0.0	0.0	0.0	0.0	0.0	0.0
J 82.0	66.6	74.3	89	1962	60	1946	6.79	15.50	1953	2.68	1949	2.83	1953	0.0	0.0	0.0	0.0	0.0	0.0
J 82.4	67.4	74.9	88	1965+	62	1947+	9.82	16.49	1958	4.25	1953	5.42	1951	0.0	0.0	0.0	0.0	0.0	0.0
A 85.1	68.4	75.8	93	1950	62	1955+	16.55	26.22	1957	4.25	1952	9.36	1957	0.0	0.0	0.0	0.0	0.0	0.0
S 82.9	68.1	75.5	92	1950	62	1950	18.50	26.22	1957	2.43	1951	6.02	1960	0.0	0.0	0.0	0.0	0.0	0.0
O 82.5	67.6	75.1	91	1965+	62	1962+	10.80	23.03	1951	2.40	1942	8.88	1951	0.0	0.0	0.0	0.0	0.0	0.0
N 80.4	65.9	73.2	88	1965+	58	1948	13.37	22.03	1959	3.78	1943	15.59	1959	0.0	0.0	0.0	0.0	0.0	0.0
D 78.8	64.1	71.5	90	1964	56	1947	15.18	50.82	1954	0.77	1963	10.50	1946	0.0	0.0	0.0	0.0	0.0	0.0
VR 80.6	65.5	73.1	94	1966	53	1962	136.62	50.82	1954	0.36	1953	15.59	1959	0.0	0.0	0.0	0.0	0.0	0.0

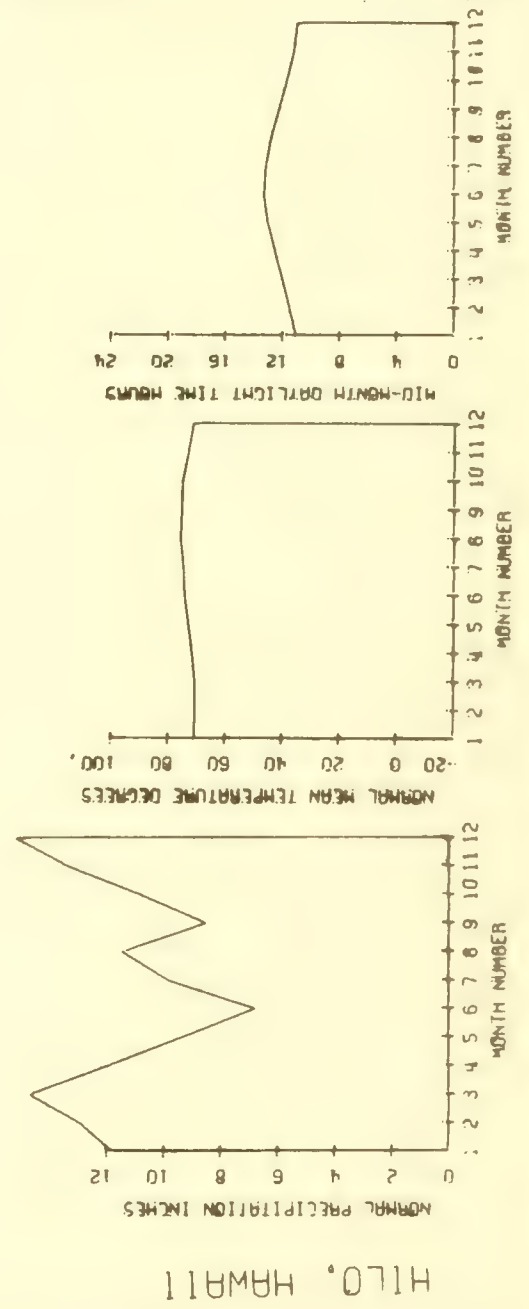
AVERAGE WIND SPEED
AND DIRECTION

HILO, HAWAII

N



SCALE - 1 IN. = 20 MPH
NOTE: THE CIRCLE DENOTES 10 MPH



Source: ESSA, U.S. Weather Bureau, 30-Year Normals

TABLE VI.1.8
Inventory Information in Other Parts of this Report

<u>Table Number</u>	<u>Table Subject</u>
IV.1.1	River Flow
IV.1.2	Sediments
IV.1.3	Climate
IV.1.4	Tidal Characteristics
IV.1.5	Dominating Environmental Characteristics
IV.1.6	Size and Shape Comparisons
IV.1.7	Morphological Classifications
IV.1.8	Natural Ocean and River Water Quality
IV.3.1	Population and Agriculture
IV.3.2	Industrialization
IV.3.3	Land Ownership
IV.3.5	Commercial Fisheries
IV.2.4	Recreation Shoreline
IV.2.5	Commercial Shipping
IV.2.7	Cooling Water Withdrawals
IV.2.8	Coastal Mining
IV.2.9	Navigation Dredging
IV.2.10	Marsh Habitat Lost by Filling
IV.2.11	Flow Regulation Structures
IV.5.4	Artificial Modifying Structures
IV.5.7	Total Industrial Wastes
IV.5.8	Major Industrial Wastes
IV.5.11	Estuarine Systems with Degraded Water Quality

SECTION 7. THE FUTURE OF THE INVENTORY

The National Estuarine Inventory was initially intended only to satisfy the needs of the National Estuarine Pollution Study. However, as the project developed, it became apparent that the Inventory, or its lineal descendant, can be of far-reaching value in the estuarine management, research, and study.

There are many agencies and groups involved both institutional and technical management planning, plan implementation, and research in the coastal zone. They are concerned at all levels--national, regional, state, county, and local. The Inventory automation system is capable of supplying all of these groups with data pertinent to their own different needs with these two advantages: First, available information can be acquired from a single source, providing a baseline of usable information with which the planner can begin work immediately. Secondly, knowledge gaps are identifiable, making it possible for the manager, the scientist or the technician to concentrate study capability in areas of true ignorance, directing their efforts to new or complementary, rather than duplicative, activities.

There is nothing new or unusual about data storage and retrieval systems. They differ only in the contents that they are written to contain.

There are many in the Federal Government, such as the detailed file of oceanographic water quality data maintained by the National Oceanographic

Data Center (NODC); the hydrologic information managed by the U. S. Geological Survey (USGS Hydrologic); the files of water quality data which FWPCA (STORET) maintains and many others. The majority of these systems are designed primarily for the scientist and the technician involved in solving technical problems in the environment. The Inventory, on the other hand, is written to contain information of a more general nature and is intended to serve a different purpose, that of estuarine management. What this means in the practical sense, is that the generalized Inventory system draws on the detailed data systems for part of its supply of raw environmental data input. The intermeshing of these four systems will be discussed in Chapter 2 of this Part.

A management information system is of negligible value unless it is used by the management and planning groups it is intended to serve. It is anticipated that these will be primarily on the state level, so a major first step is to develop a working relationship in order to determine how state agencies can most effectively use the system in contributing and withdrawing data from it. A pilot study for this purpose is being carried out with the State of South Carolina. Present indications are that a successful and mutually satisfactory arrangement can be developed for continuing application.

Universities and private organizations can also make use of the information contained in such a management information system by

working either through their respective state agencies or directly with the Department of the Interior.

The development of the Inventory into a continuing management information system must be accompanied by an aggressive program of assistance to user groups, both in learning about the information available and in making use of it. This can be accomplished through personal contact, aggressive public service, and demonstrations of how the information can be used to help solve actual problems.

A management information system such as described here would need to acquire data on some regular basis from many federal and state agencies. Much of the information to be collected on the federal level will come from agencies of the Department of the Interior; so it would be logical that this system should be a Departmental one.

A management information system is necessary to the timely and efficient implementation of a comprehensive national program of estuarine management and the first steps toward establishment of such a system have been taken as part of the National Estuarine Pollution Study.

SECTION 8. SUMMARY

The Inventory is designed to serve management by providing information over the wide range of subject areas required for satisfactory management perspective, whereas in-depth data on individual subjects is the focus of most other information systems.

It began as a means to organize and coordinate the great variety and volume of available information pertinent to estuarine management. As the program of data gathering and analysis progressed, large data gaps began to appear, and it became apparent that the Inventory would be valuable not only as a source of data but also as a delineator of data needs.

These needs fall into two categories: that for data which exist and are available though widely scattered, and that for information which has never been developed. Sources to fill the first need have been located and must be tapped and a consistent program of data gathering must be developed to fill the second need.

The highly compressed tabular data presented throughout this report consists of national and regional summaries of information stored in the Inventory on a local geographic basis. A continuing estuarine management information system can provide a local, State, regional, and national management similar current information upon which to base a program for the preservation, use, study, and development of the estuarine zone of the United States.

REFERENCES

- IV-1-1 Wastler, T.A., and L.C. de Guerrero, National Estuarine
Inventory Handbook of Descriptors. Washington, D.C.,
U.S. Department of the Interior, Federal Water Pollution
Control Administration, Rev., Sept. 1968. pp 77

Chapter 2

INFORMATION AND DATA NEEDS AS SHOWN BY THE NATIONAL ESTUARINE INVENTORY

No management program can be effective without adequate knowledge of the environment to be managed. This is especially true in the estuarine zone where the biophysical, the socioeconomic, and the institutional environments are so intimately connected and interdependent.

The Inventory contains much information on these three separate but interlocked environments. However, as has been pointed out, it also contains large areas where the required data have not been available. While the data and information required to fill these gaps are important in themselves, it is in their interrelationships that their real importance lies. There is nothing straight-forward in combined consideration of the biophysical, the socioeconomic, and the institutional environments, yet this consideration produces the fundamental rules which guide the course of technical management.

The information gathering and study program shown necessary by the Inventory is intended to serve one purpose. That is to increase knowledge of the estuarine zone enough to use, develop and preserve the estuarine resource for maximum use without undue damage now or in the future. This program makes no attempt to obtain all knowledge on the study area; it is directed toward management needs, and

therefore basic data collection and studies to supply basic data are the key features. A study program such as that presented here can be effective in management only if carried out as an integrated part of the overall management program.

SECTION 1. NONEXISTENT DATA

Compilation of the Inventory revealed that a great many kinds of essential information have never been collected in sufficient detail or with a geographical coverage large enough to be useful in overall management planning, even in resource utilization planning for small estuarine management units.

Many studies of estuarine environments have been carried out, but these have almost always been done or supported by mission-oriented agencies whose activities are directed toward the achievement of specific objectives. The extremely dynamic conditions usually prevailing within estuarine systems, combined with personnel and budget limitations, often prevents the collection of all but the most essential information.

For example, in an enforcement field study intended to determine the damages resulting from shellfish bed closures, the essential investigations would require the study of sources of pollution, their effects on water quality, shellfish habitat damage, and economic damage to the shellfish industry. A general environmental study (including investigations of sediment type and distribution, fish habitat value, oceanographic features, and recreational use, among others) would probably have to be foregone because of the lack of people and equipment to carry them out.

This limited approach toward estuarine study has severely limited the value of the information collected in each study and has made a duplication of effort inevitable. If, for instance, a fish habitat study were carried out at a time different from the enforcement study mentioned above, it would be necessary for the investigators to obtain water quality information of the same type required by the previous study, because there would be no other way of knowing if water quality conditions had remained the same.

The estuarine environments most often studied have been those with specific problems in need of solution. Those estuarine systems undisturbed by man have generally been studied only by single investigators interested in and able to work on only a few aspects of the environment. Yet, information on these kinds of systems is needed in order to understand the changes that have occurred in other estuarine environments.

The net result of historical estuarine studies has been a large quantity of partial information collected at different times and different places by different people. Only on a very few systems has a broad spectrum of synoptic information been collected. While much of the data collected is indeed still valuable, it is not now possible to use it to establish key interrelationships among the ecosystem components. The development of the information necessary to establish

ecosystem relationships is a research problem to be discussed in Chapter 3, but much of this information is required for other purposes directly related to management needs.

Information to support management efforts is lacking in most of those information categories which require extensive field survey or study to secure it.

PHYSICAL OCEANOGRAPHY

The information needed includes actual measurements of tidal, current, and stratification phenomena on many different estuarine systems.

While many estimates of these types of data are available, actual measurements are necessary to establish the true characteristics of each estuary. These measurements, together with area, shape, and size information, will provide the detailed morphological description which forms the foundation for studies in which the physical characteristics of individual estuarine management units are described in order that its capacity for use can be understood, and, of more far-reaching consequences, the studies in which one estuarine system is compared with another. A recurrent theme throughout this study--and this report--is the concept of learning enough about the nature of the estuarine zone to permit development of study methods applicable to a wide range of estuarine types.

The great amount of effort now being expended in the development of estuarine mathematical models and the attempts to apply systems analysis techniques in the estuarine zone are seriously hampered by the lack of fundamental information on the physical oceanography of estuaries. The data needs pertinent to this Section are for actual measurements of tidal, current, and stratification phenomena.

The obtaining of physical oceanographic information requires both a program of consistent routine data collection over a large geographic range and intensive case studies in individual systems.

SEDIMENTS AND SEDIMENTATION

All water, even the tiniest trickle, picks up and bears along minute particles from its bed. These particles may be invisible to the eye, but they are there and they are carried along suspended until, at some place where the current slows and gravity gets the upper hand, they fall to the bottom of the water course. These particles are "sediments" and the way in which they settle out is "sedimentation."

In some areas of the estuarine zone, natural sediment transport and sedimentation cause drastic changes. However, natural sedimentation is generally a long-term process to which the ecosystem can adapt-- that is, if a given species cannot tolerate a natural characteristic of a given environment, the species would not exist in that environment

in any case. A species sensitive to sediments, therefore, would not normally be present in turbid waters. Generally, then, natural sedimentation cannot be considered highly damaging to estuarine biota.

Man-induced sedimentation is unfortunately another story. Denuding an area of earth releases to the hydrologic system an exponentially large amount of sediments. Rainfall washing over these bare areas carries sediment loads in slugs into the surface water drainage system, disturbing the ecosystem with unaccustomed turbidity. It is frequently when these streams reach sea level--the estuaries--that the water's momentum is slowed sufficiently to permit the sedimentation process to take place. The ecosystem is disturbed not only by excess turbidity, but also by an excess sedimentary covering which coats the bottom, smothering many life forms and changing the basic configuration of the estuary.

Sediment loads in rivers are transient phenomena related to sudden increases in flow and other climatological conditions. Understanding and mastering the problems of sedimentation pollution in estuaries requires a much broader data base than is now available. Much of the necessary data can be obtained through consistent sediment load and bottom condition monitoring throughout the estuarine zone.

USES AND USE DAMAGES

A body of water may be littered with floating debris, it may be turbid and foul-smelling, and to all intents and purposes, dead, yet proving

a damage to use is very difficult. One reason for the difficulty is that damage must be measured by the yardstick of the values that were present when the body of water was clean. If no data from that time are available, precise quantification may be impossible.

Enforcement of the water quality standards will negate much of the necessity for proving damage to use, but use damage data is, and for some time to come will continue to be, the basis for evaluation and enforcement of water quality standards. The standards criteria -- actual measurements of water quality parameters--in many cases yet have to be tested for adequacy in the estuaries where so much knowledge is lacking. This is probably the most important area of neglected study indicated by the Inventory.

Use damage identification requires information on many aspects of the estuarine environment; this is one reason there is so little available at the present time. It not only requires a detailed study of water quality and sources of pollution, but it also demands an economic analysis of the damage involved.

The identification of use damages requires the measurement of various uses at different times. This kind of information is collected most efficiently through a routine program of data collection such as that administered by the Bureau of the Census. Such a program of data collection can not only show when use damages have occurred, but, when the information is studied as it is collected, such a routine basic data collection program can provide the information to illuminate damaging trends so as to counteract them before a catastrophe occurs.

WATER QUALITY AND SOURCES OF POLLUTION

In the final analysis, the greatest deficiency in basic information on estuaries is the lack of water quality data, and water quality is one of the basic environmental conditions a management program should protect. The collection of water quality information is particularly susceptible to the kind of partial effort required by the missions of many Federal and State agencies. It is easy to reduce a water sampling program by a station or two or a point or two, until the maximum is reached that the available personnel can do. While this is a necessary approach, for other users it damages the value of the data collected.

In any system receiving wastes, water quality data are of severely limited value unless coupled with data on the sources of pollution which may affect water quality.

To evaluate effects of waste discharges on any receiving body of water there are certain basic items of information which must be obtained. This information may be grouped into three general categories. First, there is the nature of the waste material itself; second, there is the manner of its movement within the estuarine system; and third, there is the way in which it interacts chemically and biologically with the estuarine environment.

None of the characteristics of waste discharges are unique to wastes discharged to the coastal environment. What is unique is that small

variations in volume, concentration, or composition of wastes can have much more impact on an estuarine environment, where wastes may remain in one area for extended periods of time, than in a freely flowing river, where wastes are being constantly carried away from an outfall. This means that waste discharges into estuarine and coastal environments must be more constantly and carefully monitored than those discharged into rivers.

The obvious means to acquire information would be 1) a stringent and wide-spread monitoring program, or 2) development of a mandatory reporting system for use by individual industrial and municipal facilities themselves. Actual implementation of either method presents equally obvious problems, however. The vast expenditure of time and money for routine monitoring of every waste outfall in the estuarine zone is prohibitive. The enforcement of a mandatory reporting system also represents more man-hours and money than are feasible to consider. Yet monitoring is a necessity, so a simple reporting method for all possible studies and existing monitoring systems must be devised and the data gathered funneled into a central location for broad-scale analysis.

The adequacy, or lack thereof, of existing monitoring systems can then be determined and broadened only as absolutely necessary.

The information needed for routine water quality monitoring associated with pollution surveillance is also needed as basic data input for management and for basic research. An effective routine monitoring

program should therefore integrate all of these needs to avoid overlapping data collection programs and insure acquiring the broad data base needed to advance scientific knowledge of the estuarine zone.

A further need related to the advancement of knowledge is basic data on unpolluted and unmodified estuarine systems; it is the lack of these kinds of data that hampers many present efforts at evaluating the effects of past changes on the environment.

Present efforts at water quality monitoring in estuarine systems are scattered; they are primarily a matter of State concern, and have been carried out directly by State agencies or through cooperation with local governments and industries. These efforts should be integrated into a nationwide water quality monitoring program designed to satisfy national as well as local needs.

SECTION 2. "GRAY" DATA

There is a vast quantity of information which would be extremely useful at all levels of management if it were readily available. This so-called "gray" data exists, but it requires a special level of effort to secure it and put it in a form useful for management purposes.

These are the kinds of information that are collected by Federal, State or local agencies as a matter of routine operation and merely filed away when they have served their purpose. For example, routine water quality measurements over shellfish beds, or a Leach access toll bridge receipts, or numbers and kinds of Corps of Engineers dredging permits issued, would all provide pertinent information to estuarine management if readily available.

These kinds of information exist also in unpublished reports on contracts designed to satisfy a need. For example, a contractor's report to a State planning board on the need for more parks might never be published but would still contain valuable information to estuarine management if it were readily available. Many unpublished reports and informal technical memoranda will be released for public use if they can be found--but they do not appear in indexes or bibliographies; special efforts are required to find them.

A third kind of "gray" data is information that is available from published material but requires particular skill or effort to extract it. For example, the areas and volumes of all estuarine systems in

the United States can be extracted from available navigation or topographic charts if someone will painstakingly measure the areas at different depth contours.

All of these data sources have one thing in common--the available information is difficult to find or extract, prohibitively so for the limited studies characteristic of the historical approach toward studying the estuarine environment. A much broader approach toward collecting such information, implemented as part of a national program, would achieve economy of scale and efficiency in operation by developing and applying the overall expertise as a centralized function.

Not all information existing in the "gray" data is pertinent and valuable for estuarine management. Examples of the kinds of pertinent information which exist primarily as "gray" data may be summarized according to their categories in the "Handbook of Descriptions" of the National Estuarine Inventory.

MANAGEMENT AUTHORITY IDENTIFICATION

Part V of this report deals with government entities and their interests and programs in the estuarine zone. Although the states have prime responsibility in most waters relating to the estuarine zone, it is at, or through the county and municipal governments that much of the implementation of a national plan must take place. This area of specific responsibility needs more complete definition.

The information needs by county are:

- (1) Governmental structure;
- (2) Its relationship to municipalities within the county; and
- (3) Range of authority concerning the estuarine zone.

The studies required are a thorough literature search on a county-by-county basis to be supplemented by direct contact where it is not possible to acquire the necessary information from the literature.

The identification of other entities who have managerial authority over an estuarine zone can help to form the basis for a continuing institutional management plan. Each segment of the institutional mosaic must be placed into its proper position, so that each entity involved can be recognized and can participate at its own level.

Other needed data is information on the types and sizes of estuarine areas already under active management by any level of government as well as those areas which are included in zoning and regional planning districts.

All of these data exist. They are filed away in county court houses, Chamber of Commerce files, and government record books. An intensive literature study and files search will be necessary to search out the required information.

HYDROLOGY AND MORPHOLOGY

In order to use a resource effectively, management first must quantify how much of the resource there is to use. In the case of estuaries--which, like all water resources, are primarily self-renewing when used properly--the quantity of water, the areas of marsh and associated lands, and the types of modifications which have been made constitute the total resource which is presently available. Most of this information exists, either in available literature or in widely scattered files.

The data required include "Fills", a tiny word, yet it represents the only final and irretrievable damage that can be inflicted on a body of water. Information on circulation-modifying structures of other types--dredged channels, bridges, causeways, small upstream impoundments, etc.--are also needed.

It is imperative that records be kept of such construction and that their effects on a system be carefully monitored. These records and monitoring data must be studied minutely in order to learn the most effective and least damaging methods to use when estuarine modification is necessary.

Considered separately these small structures--dikes, weirs, locks, etc.--appear innocuous, yet even one on a stream tributary to an estuary can have profound effects on salinity levels and current patterns. Changes in these, in turn, can upset the ecological balance of an area far out of proportion to the size of the regulation

structure itself.

Though these small flow regulation structures, along with their larger counterparts, the high dams and large impoundments, may be above tide water, their influence is as important as that of structures within the estuarine zone itself.

SOCIOECONOMIC DATA

These data describe the basic economic make-up of an estuarine-associated land area which is usually a county, since the county is the smallest unit for which data are available. The majority of data which have been assembled, including those for Standard Metropolitan Statistical Areas (SMSA's) are relatively gross. They provide an adequate picture at the State or regional level, but are generally lacking in the fine grain detail which would be necessary to do an in-depth analysis of a small area.

Some detail records have been acquired recently and the first step toward a nationwide economic breakdown of small specific areas on the coastline should commence with careful study of the material which is available in-house. A study of this type would serve two purposes: 1) full usefulness would be made of the data records already acquired, and 2) additional information needs would be clearly pin-pointed.

The continuing need in this segment of information is not so much one of locating and acquiring additional data. Emphasis should be placed,

instead, on constant updating and retention of historical records for trend establishment, and careful, detailed analyses to present clear and accurate pictures of any area, large or small.

SECTION 3. PROGRAM DEFINITION

Table VI.2.1 summarizes the important information lacks found during the initial compilation of the National Estuarine Inventory, and outlines briefly the means by which to acquire each kind of information.

The foregoing discussions showed that the major kinds of available management information can be grouped into two broad categories: that information which has never been collected, and that information which has been collected but not published or released in a usable form.

There is a need, therefore, for an overall basic data collection program including a nationwide system of routine field data collection and estuarine water quality, pollution source, and ecological monitoring as well as a system for the collection of "gray" data. As corollaries to these, however, there must be a means for handling, using, and disseminating the information being collected, and there must be a means for advancing the state of knowledge to increase management capability.

The need in the estuarine zone is not for three separate programs, but for one integrated program with the three facets outlined above. Such a program must also recognize and cope with the realities of

TABLE VI.2.1 BASIC DATA NEEDS AS SHOWN BY THE NATIONAL ESTUARINE INVENTORY (BY HANDBOOK OF DESCRIPTORS SECTIONS)

Subject	Items Required	Type of Study	Category*	Update Period	Sources
1. Identification of Estuarine Register Area	Institutional data	Literature studies supplemented by questionnaires where necessary will be required.	1,3	5 years	The States The Counties Library of Congress National Assoc. of Counties
2. Area Description	Areas, Contours, Fills, Modifications	Available publications, i.e., navigation charts, maps, books, published statistical summaries, etc., must be searched manually. Both historical and current data should be included.	1	1 year	U.S. Coast & Geodetic Survey U.S. Army Corps of Engineers U.S. Geological Survey
3. Managing Entities	Public Ownership & Management Compacts and Commissions zoning and Regional Planning	Literature studies and numerous file searches will be needed to gather data at other than Federal level.	1	1 year	The States The Counties FWPCA Regional Offices The Department of Housing and Urban Development Fish and Wildlife and Parks, USDI
4. Hydrology	Flow Regulation Structures-Locks, Dikes, Small Impoundments, etc.	Literature Study	1	5 years	U.S. Geological Survey
5. Stage of Development	Specific values added; Industrial farming and recreation activities and trends, Population shifts and trends, etc.	Selected census data as well as commercial files must be compared and analyzed.	1	1 year	U.S. Bureau of the Census Commercial Sources

TABLE VI.2.1 BASIC DATA NEEDS AS SHOWN BY THE NATIONAL ESTUARINE
INVENTORY (BY HANDBOOK OF DESCRIPTORS SECTIONS)
(continued)

Subject	Items Required	Type of Study	Category*	Update Period	Sources
6. Physical Oceanography	Current Speeds and patterns, volume, circulation characteristics	Literature studies will provide scattered data. Basic field measurements or monitoring will be required for all areas other than major ports.	2	5 years	National Oceanographic Data Center U.S. Coast & Geodetic Survey U.S. Coast Guard U.S. Geological Survey
7. Water Quality	Measurements in areas not currently described	Literature studies, file searches, basic field measurements and routine monitoring will be required.	2	Constant	The States FWPCA U.S. Geological Survey National Oceanographic Data Center
8. Sediments and Sedimentation	Detailed Data	Literature studies, file searches, field measurements and routine monitoring will be required.	2	Constant	U.S. Geological Survey FWPCA U.S. Army Corps of Engineers Fish and Wildlife and Parks U.S. Coast & Geodetic Survey
9. Uses	Recreation, Fish and Wildlife Use	Further literature studies and file searches supplemented by field studies.	1	1 year	FWPCA Bureau of Outdoor Recreation
10. Sources of Pollution	Effluent Characteristics	Routine monitoring, mandatory reporting and other methods will be required.	2,3	Constant	FWPCA The States U.S. Public Health Service

TABLE VI.2.1 BASIC DATA NEEDS AS SHOWN BY THE NATIONAL ESTUARINE
INVENTORY (BY HANDBOOK OF DESCRIPTORS SECTIONS)

(continued)

Subject	Items Required	Type of Study	Category*	Update Period	Sources
11. Use Damages	Loss of past, current, and potential uses of all types, particularly ecological	All available methods of study and research should be concentrated in this area.	1,2,3	Constant	FWPCA The States The Counties Fish and Wildlife and Parks, USDI
12. Immediate Pollution Control Needs	Identification of specific damaging waste sources.	Routine monitoring will be required.	2	Constant	FWPCA The States U.S. Geological Survey
13. Water Quality Standards	Information on compliance on an estuary-by-estuary basis	Routine monitoring and close investigation to determine whether the standards as accepted may serve purposes of estuarine zoning.	2	Constant	FWPCA The States U.S. Geological Survey
14. Past and Current Studies		Literature searches should continue and a standard reporting method must be devised.	3	1 year	All Federal agencies All Federally financed study groups

* Category #1 includes existing information for which a literature study and files search will be adequate.
Category #2 includes that information for which basic field studies will also be required.
Category #3 requires other methods.

operating a large data collection and dissemination system which depends on contributions from diverse sources.

The two-years effort in collecting information on the estuarine zone has led to these conclusions about the problems of locating and acquiring data:

- (1) Most agencies, groups, and individuals will permit ready access to their files and data records, but lack manpower and/or incentive to "assemble, coordinate, and organize" them for the use of other groups.
- (2) Large central data systems often have difficulty acquiring data, because users -- who are also the potential contributors -- frequently encounter problems caused by system inflexibility and the slowness of ponderous size, often becoming sceptical of its value and loathe to contribute information.
- (3) All data sources mentioned in Table VI.2.1, with the exception of the county governments, have been queried for this information and have already responded to the greatest extent possible; therefore, the data gaps existing in the Inventory represent the limits of present capability in providing data.

(4) Experience has shown that frequently there may appear to be a lack of data when actually the data exist but in an obscure form or place, or else held under proprietary restriction.

(5) Data are taken primarily where there is a direct economic return or a problem associated with an agency mission.

None of the problems associated with collecting management information and efficiently disseminating it to serve management purposes is unsolvable, but these problems set the framework within which a program must operate to provide needed management information to users.

SECTION 4. THE RECOMMENDED PROGRAM

A general program to acquire and organize information on the estuarine zone to satisfy management needs should consist of three equally important and interrelated activities:

1. An integrated and comprehensive program of routine estuarine zone data collection, including monitoring of estuarine water quality and habitat.
2. A centralized system for the collection, organization, and dissemination of estuarine management information in a form directly useful to managers.
3. A program of applied research investigations designed to increase knowledge needed for management.

BASIC DATA COLLECTION AND ROUTINE MONITORING

The object of this activity is to establish and maintain a nationwide program of basic data collection and environmental monitoring in the estuarine zone of the United States.

Many different agencies operate routine monitoring programs covering limited aspects of the estuarine environment. Each of these operates for a different purpose and is often uncoordinated with other efforts. Frequently this is simply because there

is no mechanism for interchanging information rapidly and efficiently at the working level so that programs of mutual benefit can be readily established.

The program recommended here should not compete with existing monitoring programs, but through providing a valuable service, should stimulate the interest of other Federal, State, local, and private entities in working cooperatively toward a nationwide program that will make use of the full capabilities of existing monitoring activities.

A nationwide environmental monitoring system can exist only if there is centralized knowledge of the program associated with responsibility and authority for implementation. The routine data collection efforts of Federal agencies, particularly within the Department of the Interior, can be organized into a unified nationwide estuarine monitoring system and coordinated with similar State efforts through amalgamating into one organization the necessary responsibility and authority for carrying out such a program without interference with the assigned missions of any agency, either Federal or State.

Within the framework of a unified sampling network, an effective nationwide estuarine monitoring program can be developed from existing monitoring programs by combining with this activity the centralized authority to supplement ongoing programs by:

1. providing to Federal agencies funds specifically allocated for broadening their existing pertinent programs;
2. supporting State programs with funds or contract support for environmental monitoring;
3. carrying out additional monitoring activities through in-house capability or by contract;
4. supporting research and development activities designed to improve monitoring capability.

This program should concern itself with the broadest possible scale of environmental information, including all categories of information incorporated into the National Estuarine Inventory. While water quality, pollution source, and ecological data are badly needed and require major effort, there should also be regularly scheduled monitoring of other aspects of the estuarine environment such as recreational demand and use.

The basic data collection and routine monitoring program should be an integral part of the overall management information system required to support management efforts.

MANAGEMENT INFORMATION SYSTEM

The object of this activity is to provide a continuing institutional and technical information service on estuarine problems. As such there should be the in-house capability of operating a large automated data and information library; but there should

also be the capability of recognizing data needs, finding and acquiring data, organizing information for management use, and developing new techniques and applications involving management information. Given these capabilities the elements of an information acquisition and service program for completing and maintaining a current estuarine management information program follow naturally from the information problem areas outlined previously.

1. Additional existing unclassified data from the Federal agencies and other sources listed in Table VI.2.1 should be compiled by contract or other arrangement. The compilation of historical data from these sources would be rather massive and it is not reasonable to expect such agencies to either assign the task to personnel who are busy with other tasks nor to acquire the temporary work force required.
2. Reimbursible agreements on contracts should be let with data contributors and others to provide for updating their input to the Inventory at specified intervals.

In those cases where Nationwide data blocks have been included in the Inventory, e.g., mining use, volumes and costs of dredging, commercial shipping, etc. only updating would be necessary.

3. A simple and direct reporting system should be implemented. All studies wholly or partially funded by the Federal Government

which deal with the estuarine zone, including associated land areas (coastal counties, coastal SMSA's or parts thereof) should be required to forward copies of raw data gathered and reports completed to a central facility for processing and cataloguing.

The reporting system should require no special form or method of submission, but simply copies of material gathered. (At the field level where the actual work takes place, special requirements of data and information submission would require too many man-hours to be feasible).

This reporting system will serve two purposes. First, it will serve as an update mechanism for knowledge being gained in the estuarine zone. Second, it will provide an accurate mechanism to help prevent duplication of effort among federally financed programs.

4. All entities wholly or partially financed by the Federal Government, which monitor estuarine water quality parameters, including sediments and sedimentation, should be identified, their sampling station locations pin-pointed, and copies of the data taken submitted to a central location for processing.

Unified identification of existing stations and analysis of the data collected would point out current coverage and permit any expansion necessary to proceed logically and without duplication.

Much of the work of identification of the sampling points used by Federal agencies has already been accomplished by the U. S.

Geological Survey and by the Federal Water Pollution Control Administration. It is among States, university groups, and Federal grant program receivers that most of the identification work should be concentrated.

5. Existing similar data systems should be used reciprocally and cooperatively to store and retrieve various data types. These systems include the Inventory, STORET, USGS Hydrologic, and NODC. The compatibility of system concept and structure of these four systems is such that they can function as complementary segments of a single large storage and retrieval system.

In data gathering, for example, each organization searches primarily for the type of data which its "software" (that is, programs -- the machines themselves are "hardware") will accept. It is inevitable that the searches will encounter information which can be stored in a sister system more efficiently; thus, a considerable amount of duplication can be saved.

6. Concurrently with data gathering, processing and servicing, there must be a constant background of analytical data information investigation to identify special needs and conditions, and to explore new possibilities and applications, both directly and by contract.

APPLIED RESEARCH

A program of research and study to advance the state of knowledge

in estuarine management is presented in Chapter 3. It is important to recognize, however, that the research program, the routine monitoring program, and the information service program are all integral parts of the overall effort intended to provide management with the ability to preserve, use, and develop the national estuarine system of the United States.

SUMMARY

The object of building and maintaining the National Estuarine Inventory is to aid in the application of existing knowledge to maintain environmental stability in the coastal lands and waters of the United States. The program of data and information collection and handling set out in this Chapter is devised to be able to supply current and accurate information to the institutional and technical manager, to the scientist and student, and to the institutions and agencies who help in the fight to preserve and maintain our environment. The prerequisites are a central facility, the men and machines to perform the labor, and constant application of a vigorous and aggressive public service policy.

Chapter 3

MAJOR RESEARCH AND STUDY NEEDS

SECTION 1. INTRODUCTION

The National Estuarine Pollution Study was specifically instructed by the Congress to identify problems and areas in which further research and study are required for the preservation, study, use, and development of the estuaries of the Nation.

This chapter will discuss these research and study needs in fairly broad terms. The intent here is to present an overview, providing a guide towards the purpose for doing research, the kind of basic information needed to designate desired estuarine uses and goals and to support a comprehensive plan of management. Next the knowledge gaps are identified and the research and study programs needed to supply this knowledge are developed. Examples of study programs to satisfy specific goals are outlined and the principles and a system of managing estuarine research and studies are proposed. Finally, the recommendations of the combined National Academy of Sciences Committee on Oceanography and National Academy of Engineering Committee on Ocean Engineering together with a scheme of priorities are presented.

By no means does this chapter attempt to present every possible need. This would be an impossible and pointless effort, for it is our task and our intent to indicate here the broad areas in

which research and study are needed and to encourage those people who have the most knowledge concerning specific problems to design and implement the special studies that will increase our knowledge.

The information needed to prepare this chapter was obtained by several approaches with the overriding goals being to represent as broad a diversity of interests and as many knowledgeable people as possible. Many people, numbering in the hundreds, have contributed generously of their time, effort, and thinking to make up this chapter. It would be impossible to mention them all and indeed, unfair, because of the variation in quality and quantity of the various individual contributions and the applicability of the various recommendations.

Some needs were identified by many people from various parts of the country indicating great importance, yet each recognized need appears as only a single item. Other needs suggested by perhaps only one person, are vitally important in a specific locality but would not have the same national impact as others.

HOW THIS CHAPTER WAS DEVELOPED AND SOURCES OF INFORMATION

The best source of information concerning needed research and studies in the estuaries is the people who work directly on estuarine problems on a first-hand basis: the scientists, engineers, planners, and economists in the various universities,

institutions, and State and local governments who will actually do the research suggested here. In order to take direct advantage of this vast reservoir of knowledge and experience throughout the country, each region of the Federal Water Pollution Control Administration was instructed to contact individuals and institutions in its vicinity who are knowledgeable and were interested in supplying information to the National Estuarine Pollution Study. The response to this call for information was generous and provided an extremely valuable and diversified array of research needs. This group also supplied many valuable concepts towards establishing a system of management of research.

In order to sample the thinking of the many organizations of learned men, letters were written to 15 selected professional societies and organizations requesting their official opinions on research needs. This group was selected as being representative of those societies whose memberships are closely concerned with the problems of estuarine water pollution and its abatement. A more comprehensive list would have introduced considerable redundancy because of the many other sources of information used. The organizations contacted were:

- (1) Atlantic Estuarine Research Society
- (2) The American Fisheries Society
- (3) American Society of Ichthyologists and Herpetologists
- (4) American Society of Limnology and Oceanography

- (5) American Institute of Biological Sciences
- (6) Ecological Society of America
- (7) American Water Resources Association
- (8) Water Pollution Control Federation
- (9) American Society of Civil Engineers
- (10) American Chemical Society
- (11) American Geological Institute
- (12) Atlantic States Marine Fisheries Commission
- (13) Gulf States Marine Fisheries Commission
- (14) Pacific Marine Fisheries Commission
- (15) Gulf and Caribbean Fisheries Commission

As discussed in detail elsewhere in the report, thirty public meetings were held throughout the country to learn what the public desired for their estuaries. Each of these meetings contained many statements of importance to the development of a research and study program. The transcripts of these meetings were analyzed in detail. The research and study needs so identified have been incorporated into this chapter of the report.

In the course of the National Estuarine Pollution Study, many special study contracts were let. Many of these requested a discussion of the research and study needs in the specific area under consideration. Information so derived has been incorporated into the preparation of this chapter.

The Office of Research and Development of the Federal Water Pollution Control Administration supplied to the Study a statement of research needs. This statement was broad in scope yet detailed where needed. This information also has been incorporated into this chapter.

Many of the Federal Government agency profiles presented elsewhere in this Study had a component concerning research activities and study needs. This information has been incorporated into this chapter.

Each State profile has a comparable research activities and needs component.

The National Academy of Sciences and the National Academy of Engineering has prepared, through their respective Committee on Oceanography and Committee on Ocean Engineering, a statement on the research needed for coastal waste management. Because of the importance of these groups and the excellence of their suggestions, this contribution has been included as its own Section within this chapter. This Section represents the thinking of a consortium of established and recognized authorities and tends to supply a cohesive and interpretive overview of the research and study needed in the estuarine zones. To a lesser extent, they also supply a scheme of priorities that will serve all beneficial uses

of the estuarine zones most effectively and serve as a guide in the implementation of the recommendations of the National Estuarine Pollution Study.

The purpose of this broadly diversified program of data acquisition was to insure that each of the user groups and conservation interests would have an opportunity to be heard and to have their recommendations for a program of research and study needs presented. The sections that follow will propose as many of these study needs as possible and will relate them to the comprehensive program of estuarine management presented earlier in this report.

SECTION 2. THE DATA BASE NECESSARY FOR EFFECTIVE TECHNICAL MANAGEMENT

It is becoming generally recognized that the basic need in estuarine zones is a comprehensive management system designed to maximize the net benefits possible. A great deal of technical and socioeconomic information is necessary for developing and implementing such a management system. Unfortunately, present knowledge is inadequate for most estuarine areas.

The knowledge required for wise and effective estuarine management must be supplied through cooperative efforts of engineers, biologists, economists, and others and incorporated into a conventionalized system of data processing and storage. The availability of data from engineering and ecological studies for socioeconomic analysis should not be merely coincidental, but should be a carefully planned objective incorporated into research designs through multidisciplinary interaction and planning.

The range of estuarine information needed transcends the scope of biological, physical, and chemical data; it must also include specific information of demographic, social, and economic significance. Knowledge of the uses and values of estuarine resources is also a requirement of this data base. We must also be fully cognizant of the institutional arrangements operating in the estuarine zone, for any management program must operate within the legal and political framework applicable to the specific estuary under consideration.

A full and adequate knowledge of these three broad categories of information - technical, socioeconomic, and political - is inextricably related to establishing goals and assigning uses for individual estuaries or estuarine regions. The assignation of desired uses of a natural resource is a basic management decision which requires the kinds of information discussed above.

The overall purpose of applied research and study is to provide the knowledge required to establish and implement an effective comprehensive management program which will achieve optimum beneficial uses of the Nation's estuaries. This, of course, calls for a sequence of intermediate steps. The very first thing that must be done is to collate the currently known biological, chemical, and physical conditions of each portion of the estuarine zone. This assemblage of information should also indicate the current uses of the estuarine zone, its resources, the management situation currently in effect, and the problems and dangers that exist. This body of knowledge, the initial data base, is essentially the content of the National Estuarine Inventory (NEI) discussed at length in Chapters 1 and 2 of Part VI.

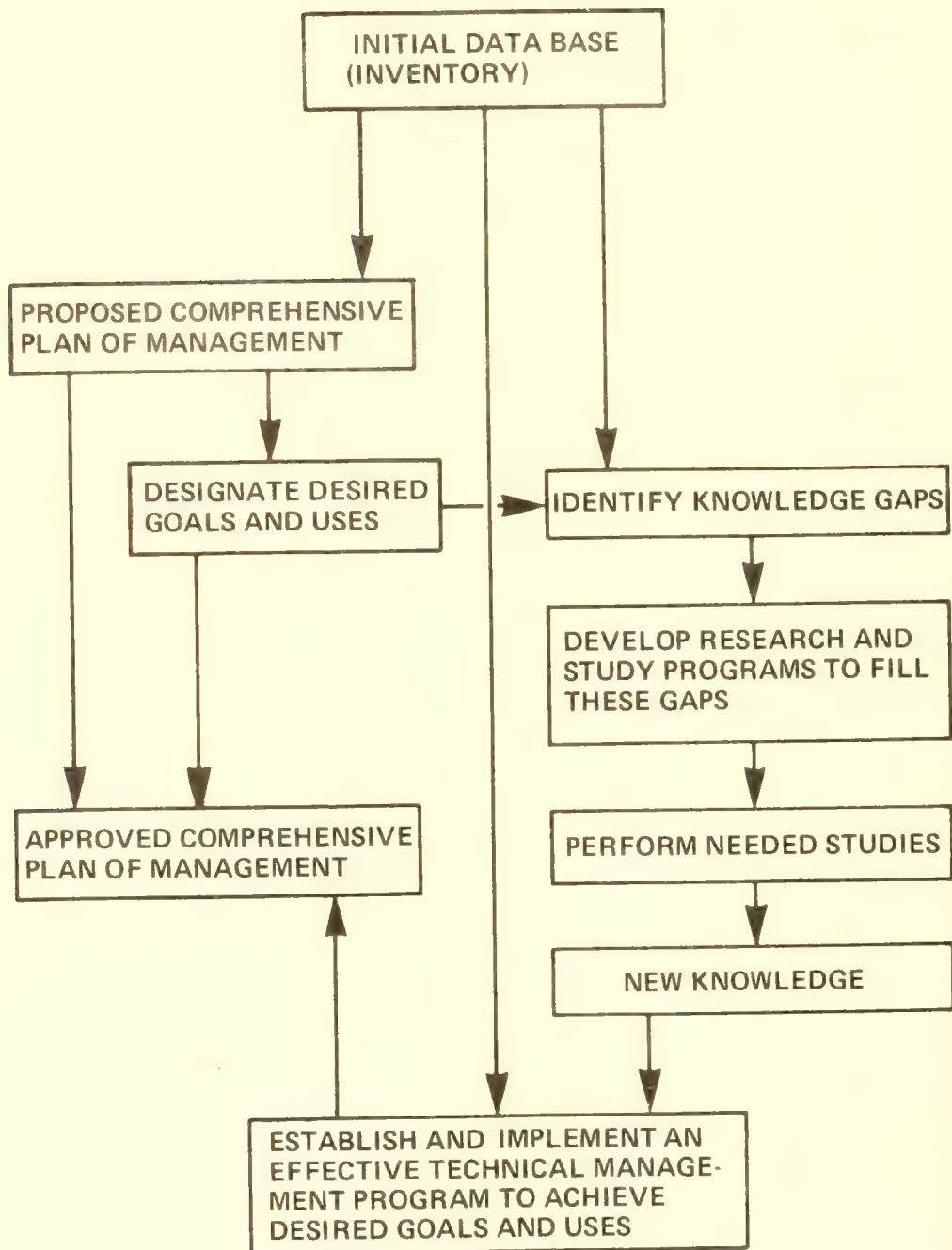
The National Estuarine Inventory is based on a series of handbooks which will fully describe each segment of the estuarine zone. Information is recorded under the following classifications:

- (1) Identification of Estuarine Register Area
- (2) Area description

- (3) Managing entities
- (4) Hydrology
- (5) Stage of development
- (6) Physical oceanography
- (7) Water quality
- (8) Sediments and Sedimentation
- (9) Uses
- (10) Sources of pollution
- (11) Use damages
- (12) Immediate Pollution Control Needs
- (13) Water quality standards
- (14) Past and current studies

Based on this assemblage of present knowledge, we develop a proposed comprehensive plan of management and designate desired goals and uses. This, of course, frames the questions of feasibility of such goals and uses. Reference again to our known data base identifies the knowledge gaps -- the knowledge we must have to make proper decisions on uses and the knowledge which is needed for effective technical management to provide for the desired uses. Identification of these knowledge gaps then leads rather directly to the development of the most essential research and study programs. The results of such programs augment the initial data base and provide the required information for both political and scientific management. This sequence is shown diagrammatically in Figure VI.3.1.

FIGURE VI.3.1 RELATIONSHIP BETWEEN KNOWLEDGE AND COMPREHENSIVE MANAGEMENT



In order to serve its purpose as a management tool, this data base must satisfy five broad requirements. These requirements are:

(1) baseline knowledge of biological, physical, and chemical data describing the estuarine zone, (2) knowledge of the institutional framework governing each portion of the estuarine zone, (3) knowledge of the demographic, social, and economic factors and their trends affecting the estuarine zone, (4) an establishment of goals and uses so that future studies can be relevantly oriented, and (5) an augmentation and synthesis of the previous four adequate to permit estuarine management. The next portion of this Section will discuss each of these requirements in greater detail.

THE NEED FOR BASELINE STUDIES OF BIOLOGICAL, PHYSICAL, AND CHEMICAL FACTORS DESCRIBING THE ESTUARINE ZONE

The need for baseline studies is so basic and so obvious that it frequently is overlooked. Simply stated, a physical, chemical, and biological inventory must be conducted of all important estuaries and as many as possible of those of lesser importance. The purpose of such inventories would be to establish conditions as they are now; a baseline against which to determine the nature, extent, and rate of any future change. Research programs ensuing from this information would be addressed toward two basic questions: (1) what forces and combination of factors made each estuary the way it is, and (2) what must be done to make (or keep) each estuary the way we want it to be.

There are the compelling reasons for establishing baseline conditions and for developing background information now. An inventory of all estuarine areas to determine their condition precedes prediction of their potential for supporting valuable living resources along with other desired uses. We also need to know what is happening to such areas; how and to what extent they are being altered or threatened. Biological, chemical, and physical baselines must be established as a foundation for further studies and evaluations. Some work of this kind has been done or is under way, but much more remains to be done.

THE NEED FOR SOCIAL, ECONOMIC, AND DEMOGRAPHIC INFORMATION

In the final analysis, the success of a management program is measured in terms of satisfaction of human needs and desires. Thus, the purpose of a management program is to provide the most benefits to the most people with the least amount of conflicting use - in brief: accurate resource evaluation and optimum beneficial resource allocation. The information needed for this is not as clearly definable as it is for technical purposes because the uses, values, and goals are not as quantifiable. This portion of an inventory would detail historical, present, and proposed specific uses and values within the estuarine zone; damages to use from pollution and other causes; demographic distributions and trends; transportation and navigational facilities; industrial installations, impact, and values; recreational benefits and potential, aesthetic demands; economic values associated

directly with the estuarine zone; sport and commercial fishing use and value; home development, and the alternatives and potential of as yet undeveloped parts of the estuarine zone.

THE NEED TO KNOW THE INSTITUTIONAL AND POLITICAL ARRANGEMENTS OF EACH PORTION OF THE ESTUARINE ZONE

The institutional and political organization of each part of the estuarine zone is the framework within which any management program must operate. It is thus axiomatic that detailed knowledge of all aspects of these arrangements are an intrinsic part of the data base needed for management. Such information includes: the political make-up of the estuarine zone, i.e., the States, counties, municipalities, and special districts and/or interstate groups involved; the legal responsibilities and authorities of each of these; groups with management responsibilities in the system; existing zoning information and other applicable governing regulation; water quality standards and status of implementation; and Federal activities in the estuarine zone.

THE NEED TO ESTABLISH GOALS AND USES

The data base described earlier is prerequisite to the establishment of goals and uses in the estuarine zone. Once these are established, they form a vital portion of the data base because

the acquisition of further information is governed by the desired uses. Hence, we must know what we want to achieve. We must know where we are going. Goals and uses for each estuary and the various portions within each estuary must be established. Goals must be identified in terms of long, medium, and short-term achievements. Uses must be established from an objective point of view. It must be accepted that not all waters are suitable for all purposes. Potential uses, conflicts, and alternatives for development must be identified, described, and evaluated. This knowledge is essential to the setting of priorities for research, planning, and other actions.

This brings us to the hardest decision of all, for after uses are designated and alternatives are identified and evaluated, specific goals must be established. Then trade-offs must be made and sacrifices must be endured if, indeed, optimum benefits are to be achieved. With respect to all that needs to be done, we must not lose sight of our objectives. Where will we be able to swim that we can not now swim; are there places for boating where we do not dare boat now; are our water-front environments unhealthy or devalued, and if so, should these values be restored; can and should we safely and successfully grow shellfish where they can not now be grown; what are the health, recreational, and commercial effects of pollution from large vessels or small boats or from casual uses of our waters; where might we catch fish that

none can now be caught; are there water-borne diseases and what measures will correct them; what values should we place on the physical properties of width, depth, and appearance of water which must be restored or preserved; what will be the long-term effects of excess plant nutrients? Then, with respect to all of these and similar questions, we must necessarily balance against lost values, the burdens which their correction will create and be sure that the burdens we create are commensurate with the values regained.

THE NEED TO AUGMENT AND SYNTHESIZE BASIC KNOWLEDGE TO PERMIT OPTIMUM ESTUARINE MANAGEMENT

The quintessence of any management system is the development of predictive capability. Having established the goals and uses; having established the knowledge of the potential, the capability, and intrinsic values of our estuaries; we must then know what will occur in response to a given stress or stimulus or activity of man or nature. It is this ability of prediction, of knowing what would be the sequelae of our actions, that will enable us to truly manage our estuaries in an intelligent fashion.

The way we technically manage a specific estuary depends upon the goals established for that estuary and on what uses we wish to make of it. The research program to support this technical

management is then dependent upon the goals and uses we have selected. All information gathered and studies performed must be oriented towards developing predictive capability if the benefits of wise management are to be attained.

SECTION 3. MAJOR KNOWLEDGE GAPS AND A PROGRAM OF NEEDED STUDY AND RESEARCH

This section introduces the discussion of what must be done to provide the data base outlined in Section 2 coupled with the analysis, research, and study required to provide the knowledge and understanding necessary to support a program of technical management. We intend to identify the major problem areas in which there are large knowledge gaps and concurrently present research and study programs that will provide the needed information. We will also discuss the kinds of research that will supply a basis for decisions that will optimize beneficial uses of the estuarine resources. The research programs proposed below are designed to recognize and interpret the causal relationships that are an integral part of any research program of value for management decisions. This understanding of causal relationships is the key to developing the capability to predict the effects of natural and man-induced activities on the estuarine zone, and, hence, to manage them.

Any discussion of knowledge gaps in major problem areas leads naturally to a description of the broad programs necessary to satisfy this need for information. Thus, as such gaps are identified, the remedial research and study activities are developed and incorporated into the appropriate discussion.

There is no attempt to exhaustively list research projects but rather to delineate the broad areas which need further study. Many of these

research and study needs to not conveniently fall into categories or disciplines. In fact, most of them do not, reflecting the complex interacting nature of the estuary itself: a complex of air, sediment, ocean, freshwater influx, marsh, beach, or rock, and the estuary itself. Because of this, problem areas have been identified largely on the basis of kinds of approaches that will yield meaningful results.

A study of all our sources of information, recommendations received, replies to specific requests, and symposia on research needs leads to the opinion that our most important knowledge gaps and thus the most imperative research and study needs lie in the following major areas:

- (1) Ecology, taken to include baseline studies, broad ecological studies, biology, water quality, natural variability, and interface factors;
- (2) Toxicity, taken to include bioassay and methodology, sublethal effects, and mortality phenomena;
- (3) Microbiology, taken to include the regeneration of plant nutrients, biodegradation of organic wastes, the phenomenon of eutrophication or over-fertilization to cause nuisance conditions, and pathogenic organisms to either humans or aquatic organisms;
- (4) Physics and mathematics, taken to include hydraulics, sedimentation, effects of structures and physical modifications, physical and mathematical modeling;

(5) Socioeconomic factors, taken to include planning, economics, law, social and demographic factors and trends, resource evaluation and allocation, and the role of technical research and study in supporting a comprehensive management plan; and

(6) Ancillary research and study needs, taken to include environmental monitoring, methodology (both laboratory and field techniques), data processing, training needs, and estuarine zone laboratories.

Bearing in mind that each of these categories overlaps the others to a greater or lesser extent and that no one of them is truly meaningful in the absence of consideration of all the others, knowledge developed in any one of them must be integrated with the others to develop the broad understanding of the estuarine zone necessary to implement a useful management program. The Sections that follow, 4 through 9, will discuss each of these categories in greater detail and present a relevant program of study and investigation.

SECTION 4. ECOLOGY

Ecology is the science of the interrelationships between living organisms and their environment. As such, it encompasses all of the natural biological, physical, and chemical aspects of the estuarine and coastal zones. The overall complex formed by the community of organisms and its environment is called an ecosystem. The discussion below deals with certain aspects of the ecosystem, why these are especially important in a program of technical and comprehensive program of estuarine management, and the most urgent knowledge gaps concerning these ecosystems. The various kinds of ecological research needed lie in the categories of baseline studies to provide basic data, broad ecological studies to determine mechanisms and ecosystem interrelationships, biological studies to elucidate purely biological phenomena, water quality studies to understand the physico-chemical environment, natural variations to differentiate against man-made changes, and interface factors to account for exchanges between the estuarine ecosystem and its bordering influences.

BASELINE STUDIES

Purpose

The most important gaps to be filled by a baseline study are a knowledge of the physical and chemical characteristics, identification, distribution, diversity, and abundance of resident and non-resident organisms, exhaustive studies of their interactions,

and the underlying causes for these characteristics. This would permit classification of each estuary into a characteristic habitat type and prediction of the productivity of fish, shellfish, wildlife, and other renewable resources for each habitat. Properly conducted baseline studies would increase understanding of the causes and mechanisms of natural and man-made fluctuations in species abundance. Baseline studies would be necessary before considering the merit of preserving certain estuaries in their present condition for future comparative reference. Perhaps the most valuable benefit to be derived from baseline studies is information bearing on the key management question of how much natural habitat -- estuary, marsh, lagoon -- is required for the maintenance and production of adequate numbers of desired species of plants and animals.

Studies of Unpolluted Estuaries

Knowledge of baseline conditions is particularly important in estuaries relatively unaffected by man's activities. These pristine areas serve as controls for purposes of comparison with bays that have been modified to various degrees by human activities. It is extremely difficult to assess changes in the productivity or the decline or disappearance of economically important species without sufficient background information. In some cases, such changes can be attributed fairly accurately to specific causes such as pollution, over-exploitation, or natural variation. On the other hand, the general decline of a species over a wide geographic area, such as the Olympia oyster

over much of the Pacific Northwest, suggests subtle ecological changes which are much more difficult to assess. It would be invaluable to be able to compare existing water quality conditions in given estuaries with conditions as they were fifty years ago. One wonders, for example, how seasonal and annual stream flow regimes have changed due to human activities in watershed areas and how such changes have affected the estuarine environment and hence the indigenous biota.

Necessary Kinds of Information

The information needed as a base for technical management should be in the form of an outline describing the Nation's coastal areas. To resolve questions of best estuarine use, necessary information includes the following: size and shape, existing water quality, degradation, sources and types of wastes, climate, hydrology, circulation, ecology, present and potential habitat value, identification, distribution and abundance of organisms, physical modifications, bathymetry, and bottom conditions.

BROAD ECOLOGICAL STUDIES

Scope of Ecological Studies

Broad ecological studies are needed to integrate all of the factors acting to shape the nature of the estuarine zone. We need to expand the baseline research on estuarine systems to include studies on nutrient and thermal additions, circulation and transfer of substances

and energy, productivity, species interaction, effects of pollution, biological indicators of environmental change, and ecosystem analysis. The broad impact of economic poisons*, must be identified and quantified. What are the sources, effects, and fate of the various pesticides and herbicides, and how may these effects be mitigated? What are the details of the life histories and environmental requirements of estuarine-associated and estuarine-dependent species? Studies should be conducted to determine the dependence of marine species on estuarine nursery areas, to measure the impact of inland development on the estuarine ecosystem, and to determine the quality and quantity of fish and wildlife habitat areas necessary to maintain present population levels and to satisfy predicted future use. Studies should be implemented on rare and endangered species of fish and shellfish. One of the most important gaps remaining is our lack of knowledge of the dynamics of food chains, the relationships between phytoplankton on one end of the food chain and fish at the other, especially quantitative data on biomass and replacement rates of both benthic and pelagic invertebrates which are not of economic value themselves but are important parts of the food chain or, in some cases, are antagonistic to economically important species.

Energy Flow in Food Webs

Much study is required to determine the absolute and relative contributions of phytoplankton, spermatophytes such as turtle grass and

*Pesticides, herbicides, defoliants, rodenticides, etc.

Spartina, and organic detritus to the energy used in these food chains. This concept of energy transfer is one of the most important aspects to understand in order to efficiently manage complex estuarine environments, for it is a fundamental property of the system and provides an extremely valuable approach to evaluation of the effects of pollution and change. It is essential to be able to quantitatively describe the energy transfer for individual species, for trophic levels, and for communities. Constructive manipulations of the sequential nature of energy transfer and utilization can be achieved by the application of system models for studies on movements and rates of transfer of selected pollutants within the system, such as insecticides and heavy metals. Such programs are dependent upon the availability of raw data on input to the ecosystem, bioconcentration, sedimentation, and output from the ecosystem. One of the early requirements in any management program should include an energy budget analysis.

Ecosystem Rehabilitation

Research is needed on the recovery of an area during the course of cleaning it up. How long does it take, what indications do we have along the way, and how will cleaner water effect the area: for example, will there be more fouling and wood borer problems? Is just the removal of pollution enough to reclaim an area or do we need to develop techniques for rehabilitating despoiled estuarine areas and for increasing fish and wildlife production in low value habitats? How do we reconstruct a marsh after dredging, filling,

and channelization projects, if, in fact, we can reconstruct a marsh ecosystem? Another need is to establish the time required for an estuary despoiled by over-fertilization and decreased flushing to reestablish a normally diverse flora and fauna upon stoppage of nutrient input and increase in flushing rate. This could be accomplished by constructing experimental embayments using survey data available for known polluted areas; and by developing model analogs based upon existing survey data and experimental results. Progress on reconstruction and rehabilitation of a despoiled estuarine area is based again on the information which would result from exhaustive detailed baseline studies described earlier.

Ecosystem Management

The use of systems analysis techniques to determine the effects of various changes in the environment and harvesting techniques on population levels is extremely productive. It seems that some of the very critical problems of estuarine and continental shelf resources, such as trash fishing, may be amenable to such analysis. In no other way can we ever hope to determine what the effect of removal of a certain portion of a population at a given age would have on the ability of the population to survive and multiply. Based on this kind of data, we could satisfy the need to develop better estuarine husbandry programs, and aquaculture might be more profitably and productively pursued. Fish production might be increased by altering currents and by other means. Mitigating

effects of environmental alterations, controlling disposal of waste products, controlling fish diseases and predators, and developing genetic strains of desired species more suited to moderately disturbed habitats might possibly ensue from a sophisticated analysis of the above factors. Certainly we should know more about the effects of any changes in the estuarine environment on the increase or build-up that might be expected of aquatic weeds, pest species of insects and other arthropods, and diseases and predator species that may reduce populations of desirable organisms or inhibit recreational uses of estuarine areas.

BIOLOGICAL STUDIES

Estuarine biological systems are extremely complex when compared to freshwater or truly marine environments. The areas between the freshwater and the sea remain the biological link between the systems which, if broken, will result in the elimination of many valuable resources. The planktonic stages which are characteristic of life histories of species having commercial or recreational importance are especially vulnerable to environmental changes.

Sources of Food

The complicated food chains, associated with the polymorphic life histories of estuarine organisms are poorly understood. For example, the American oyster, which is often called the most thoroughly studied of all estuarine organisms, can starve in waters containing

large populations of certain unicellular green algae which appear to be as suitable for food as other green algae on which they thrive. There needs to be more definitive work done on the actual sources of food used by various estuarine organisms, particularly those of commercial importance, as well as the specific kinds of food. We need to know how much of the diet of the given species comes from a given source. This is particularly true for the detritus feeders. We need to know how much detritus eaten comes from salt marshes; how much from freshwater sources up-river; how much from submerged aquatic vegetation; and how much from other sources. Better knowledge in this area is necessary in order to make intelligent decisions about how much of a given sort of habitat is necessary to "carry" a given level of resource. A better understanding and more knowledge of carbon fixation by plants in estuaries is necessary, for this is the basic source of all food for all levels of animals in the estuary.

The Estuary as a Nursery

We need to identify what is in the estuarine environment that makes it so suitable a nursery for larval and juvenile animals. This in turn means identifying, among other things, individual steps in food webs. Enough aspects should be investigated to allow us to make estimates of energy turnover. We already know that ocean basins are nutrient traps - places where energy is trapped and not returned to the cycle. What is the role of estuaries in this "running down" process? Do fine sediments act as traps for organic and inorganic

particles which are then used by bacteria, and what organisms might "graze" on the bacteria?

An important link in the food webs of the estuaries is the plankton serving as a food supply for higher, more predacious organisms. These higher predators are in the estuary as permanent residents, as migrants coming in to feed, or as organisms that may use the estuary as a migratory path going upstream or downstream, during which time they might be feeding. One often hears of the conservation efforts directed towards such major sport fish as the salmon, but little emphasis is placed on the conservation of lower members of the food web which are quite important, not only to forms such as salmon, but also to all of the other forms utilizing this basic food stuff of the ocean as a food supply. In brief, we must determine the degree to which estuarine and off-shore commercially and recreationally important fishes, and their respective food chains, depend upon the estuary.

Habitat Requirements

We must determine the fish and wildlife habitat areas necessary to maintain adequate population levels for future uses in the estuaries of food organisms, as well as the desirable species themselves. This question of adequate habitat has proved to be a very difficult determination to make, in view

of the lack of positive knowledge of the quantitative requirements for marsh, as well as other estuarine environments as nursery and habitat areas for fish and wildlife and for other purposes. Substantial research must be devoted to this question, meanwhile attempting to preserve marsh and other coastal regions to the greatest extent possible through influence on permits for dredging, filling, draining, or other modifications of estuarine zones.

An extension of the study of necessary habitats would be to determine in quantitative terms, the importance of the estuary as a spawning area, and then its importance as a nursery area. These data on life cycle events, population dynamics, food chains, nursery, habitat, spawning area values, may exist already in one form or another, but they are certainly not generally available. They need to be drawn together in a way so that they can be used by the resource manager.

WATER QUALITY CONSIDERATIONS

As indicated in the discussion on baseline studies, it is essential to have a full knowledge of the characteristics of the receiving waters in the development of a realistic program for pollution control and water quality management. In most cases, the pollutional control characteristics are unknown for the various estuarine areas. These characteristics need to be established for each estuary. While some basic data concerning

expected norms can be interchanged among estuaries, much work with each individual system is needed to establish the validity of such interchanges.

Effects of Combined Wastes

Residential, recreational, agricultural, and industrial development of the estuarine zones is proceeding at a rapid rate. These activities frequently result in highly complex waste waters from many sources that eventually become mixed in the bays and oceans. While the toxic and other characteristics of some of the individual types of waste water have been studied, effects of combined waste waters, including synergistic and antagonistic effects, are largely unknown.

Water Quality Requirements For Fish, Other Aquatic Life and Wildlife

Having learned something of the water quality of the estuaries, the next step is to ascertain the water quality requirements for the estuarine and near-shore environment. At the present time, knowledge in this area is incomplete, with the resulting tendency to use criteria that have been developed for freshwater systems. Because of the complexity of the marine system, many of the measures used in the freshwater environments are of questionable value or at least difficult to interpret. Although there has

been a considerable amount of work done, there still exist gaps in our knowledge of water quality requirements for the various finfish, shellfish, organisms that comprise their food chains, and other marine species. Further, much of the work that has been done on the subject has addressed itself to toxicity limits which determine the level of various materials that are fatal to marine species. This approach is undesirable because of the objective for management of the marine environment is not to determine the minimum level or quality that can be tolerated, but is to maintain the quality that is necessary to sustain and enhance the fishery production and other beneficial uses of marine areas. This requirement is of particular importance because the estuaries and near-shore zones comprise the nursery grounds and habitat for 75 percent of the important marine species.

Water Quality Requirements for Plants

We must be careful to concern ourselves with the plants as well as the animals present in the marine environment. Environmental, chemical, and physical requirements of important species of inshore and estuarine phytoplankton should be determined with reference to the major cations (sodium, potassium, calcium, magnesium), minor cations (manganese, molybdenum, zinc, vanadium, cobalt, copper, iron, strontium), anions (chlorine, boron, fluorine, iodine, nitrogen, phosphorous, silicon, carbonate, ammonium, sulphate, sulphite, sulphide, bicarbonate, nitrite, and nitrate), vitamins (B_{12} ,

biotin, thiamin), light (photo-period, intensity, spectral distribution), temperature (ranges, optimum, rate of change), pH (range, optimum, rate of pH change adaptation), and eH (ranges, optimum, and rate of eH change adaptation).

Determination of the amount and chemical identification of naturally occurring anti-metabolites present in sea water and determination of their effects upon the abundance and distribution of important phytoplankton species should be made. Information so derived could be very useful for managing water quality that would inhibit undesirable organisms.

Water Quality Requirements for Recreation

Water quality research should not be dominated by concern for fish and shellfish alone but should also give a major consideration of water quality requirements for the preservation of aesthetic and recreational uses of the estuarine and near-shore areas. The need for intensive research on water quality requirements for recreation is directly related to the optimum recreational carrying capacity of the estuarine area. This is particularly true for the effect of multiple pollutants acting at the same time in the same location. Consideration should also be given to public health implications; for example, the present coliform criteria for oyster production areas is highly questionable in the light

of present knowledge on bacterial re-growth and the relationship of this indicator organism to the probable presence of disease-producing organisms.

The Need for Non-harmful Discharges

Waste water quality criteria should be developed to assure that the discharge of waste to natural receiving waters results in a neutral or beneficial effect upon the biota of the receiving waters. Many estuarine animals are capable of ingesting and eliminating heavy metals without harm when these elements occur in natural ratios.

Artificially induced imbalances, however, can result in ingestion rates exceeding elimination causing accumulation of heavy metals in the tissues. For example, in long-term bioassay tests, severe oyster mortalities occurred due to minute amounts of chromium, nickel, and molybdenum originating from a stainless steel water intake line.

The gradual increase of heavy metals and other trace elements over background values are an outstanding example of a subtle kind of ecological change in our estuaries. There are many sources of metallic contamination, some of which are known, others not even suspected. One wonders, for example, about the quantity of heavy metals originating from the use of water in households. There are many miles of copper tubing and galvanized water piping in our modern urban dwellings subject to corrosion and leaching, releasing unknown quantities of copper and zinc.

Oil

Because of the increase in oil pollution and the associated use of oil dispersants, it is urgent that a better understanding of degradation processes involving both treated and untreated oil spills be reached without delay. The extent and kinds of effects exerted by oil dispersants must be known so that appropriate reactions can be made when an oil-spill-induced emergency occurs. For example, oil or petroleum concentration, per se, at high levels is considered deleterious to the ecosystem and maximum levels of oil or grease are established for estuaries. However, evidence from both the Torrey Canyon and Santa Barbara oil spills indicate that some crudes and petroleum by-products are excellent substrates for many organisms, becoming part of an enriched food chain, while others may be either poisonous or have virtually no food value. Thus, one must know not only how much oil and grease is present, but also their compositions and their effects on important plants and animals. Much of the mortality in these accidents was caused by the dispersant and not by the crude oil.

NATURAL VARIABILITY

A major gap in our knowledge of estuaries is an understanding of natural variability. While there is a growing backlog of information on natural variability within populations of certain

estuarine animals, the fluctuation of those parameters of the environment (such as temperature, dissolved oxygen, salinity, CO_2 , pH, turbidity, etc.), which are recognized as controlling mechanisms for population distributions, are poorly understood. Maximum and minimum values, duration of excursions (period of increase, plateau, and decrease), and time trends (ranging in intervals from hours to decades) in these environmental parameters must be intensively studied so that pollution effects due to man's activity may be separated from natural environmental fluctuations. We must also develop knowledge of the natural variations in water quality that are encountered in estuarine and near-shore areas in order to provide a basis for interpreting changes that are brought about by human activity. Tidal flats and other estuarine areas rich in various biological forms are highly productive. There is a continual cycle of life, production, death, and decay in these areas which apparently operates at a much higher level of activity than might be encountered in fresh water systems. The magnitude of water quality variations, caused by these natural effects is for the most part unknown. Without knowledge of natural variations in water quality, it is nearly impossible to set water quality standards.

Range of Natural Variation

An outstanding illustration of the need for understanding natural variability is found in the Patuxent River, Maryland, estuary

studies. A long term drought has resulted in an intrusion of a saline wedge into the upper reaches of the river. A power plant has been introducing thermal effluents into the river. It has been impossible to distinguish between thermal effects and effects of the saline wedge (resulting from a long term natural fluctuation) on the river animals in many instances. In this case, a history of intensive physical observations, correlated with occasional biological surveys accumulated over an extended period of time (such as has been extensively discussed earlier in connection with baseline studies), may well have resulted in a basis for separating the natural from the man-made alterations in animal populations. These observations need not have been carried out on the Patuxent River itself, but rather need only to have been concerned with the detailed documentation of saline encroachment into a brackish system. Another example of the importance of knowing natural variations occurs in the bays along Texas, Louisiana, and other areas of the Gulf Coast. In general, these bays are shallow bodies of water with large surface areas. They are thus subject to natural build-up of temperature and salinity. While the fauna of these areas has adapted to the natural build-ups, the discharge of heated waters and reduction of freshwater inflows may result in build-ups to a level above that of any natural condition. In order to provide a firm basis for the evaluation of the

effects of proposed thermal and high dissolved residue content waste discharges, investigations into the temperature and salinity characteristics of each estuarine area are needed. Correlated with this is the need to understand the biological principles of estuarine management.

Timing of Natural Variation

For the most part, we know that brackish water is necessary for the maintenance of a large fraction of our coastal fisheries. We do not, however, know exactly what are the limits of salt concentration that will encourage optimal development of desirable species. In addition to this, we have little idea of the optimal seasonality of salinity changes. Although it is apparent that a seasonal fluctuation of salinity may be desirable, we scarcely have an idea as to when it would be best to reduce or raise the salinity. We do know when certain important food animals reproduce, so we might assume that reduced salinity would be most optimal at this time, but we do not know what would be the effects of raised salinities in other seasons. All work of this kind on natural variations ties back to the baseline studies proposed earlier in this report.

INTERFACE FACTORS

An important portion of understanding the ecology of the estuarine system is a knowledge of interface factors. By this we mean

the exchanges which occur between the estuarine waters and offshore waters, the influx of freshwater and other drainage from the land; between the water mass and the bottom sediments; and between the water mass and the atmosphere. Another area of interface concern, the movement of materials between the biological compartment and the aquatic compartments of the estuary, is the major theme of much of this chapter and hence will not be discussed here.

Land Drainage-Estuary-Sea Interface

Because the estuary itself is the interface between the sea and the land, the ocean-estuary interface and the estuary-land drainage interface are complimentary in many ways. The alteration of either one is reflected in the change in effect of the other. In some cases the estuary is a gradual continuum from fresh to sea water; in others the lines of demarcation are abrupt and well-defined. The most obvious physical demarcations of land drainage-estuary-sea are based on salinity, thus, the discussion of these two interfaces is combined.

It is established that various biological life is dependent on salinity gradients throughout the estuarine zone. For example, the high value of the Gulf Coast shrimp industry is dependent on the bays as nursery grounds; however, the amounts and quality of fresh water required to support the ecological system of each individual bay has not yet been established. This is a pressing research need.

Freshwater inflows of many of our bays have already been reduced or altered through construction of upstream water supply dams. In addition to the obvious effect of increasing salt water intrusion into fresh water systems of the riverine flows, we must also know how the estuarine habitat is being limited by this increased salinity due to increased ocean influence and the reduced mass of water in a more brackish condition. The same question might well be framed with any of the many other forms of parameter alteration that have occurred. Temperature increase in critical areas might be extremely important, perhaps far in excess of the actual amount of water being affected, for if a critical area is affected, we might find ourselves with a situation of a "gate" that has been closed and whole areas of a formerly beneficial ecosystem removed from use by desirable organisms.

Residual Pollutants

Residual polluttional material such as trace organic compounds and minerals, pesticides, herbicides, heavy metals, etc., are reaching estuarine areas from either surface runoff or riverine inputs. The specific kinds, amounts, and effects of these compounds are

generally unknown. Investigations are needed to identify and quantify the residual pollutants and to evaluate their pollutional effect. These investigations should include, but not be restricted to, shellfish tissue build-up of residuals, tainted fish flesh, destruction of food chains, and inclusion into other standing compartments of the estuarine ecosystem such as the sediments, the marsh, or the major rooted aquatic plants therein.

Contiguous Wetlands

There also needs to be a thorough study of the relationship of contiguous wetland to estuarine ecological systems, including the effects of drainage on estuarine water quality. The salt marshes which are irregularly flooded are especially important. These are areas which are flooded by tide only at sporadic intervals, and consequently, there is no regular interchange of water with the estuary. It has generally been assumed, and what scanty data are available support the assumption, that such marshes contribute very little to the estuary in the way of organic matter and nutrients. The case for the importance of regularly flooded marshes has been made convincingly and consequently there is general agreement on the importance of their preservation.

People tend to regard the irregularly flooded marsh as expendable, and the pressures for modification of this habitat rapidly are becoming greater. More data is needed in this area in order to make informed decisions as to whether or not we can sacrifice large acreage of the irregularly flooded marsh. One of the most active programs in these areas has been ditching and draining for mosquito control. There is considerable disagreement as to the impact and value of this kind of activity; it can be argued that it is beneficial - while others feel that it is detrimental. Probably a case can be made for both points.

Bottom Sediment - Water Interface

The bottom sediments represent an important element in the balancing of the marine community and must be included in any consideration of estuarine management. Disturbing these sediments by dredging or by the working of bottom animals such as worm and fish, can reintroduce materials which have become associated with the bottom sediments into the water mass. Heavy metals, pesticides, herbicides, nutrients, oil residues, and many industrial chemical mixtures are examples of the kinds of materials which become incorporated into the bottom. For example, lead is found present in almost all types of deposits in amounts varying from 70 to 580 parts per million on a dry mud basis. Most of this lead comes from atmospheric pollution which has passed through the

waters, precipitated, and adsorbed to bottom sediments. The presence of high concentrations of copper varying from 209 to 600 parts per million on a dry mud basis are also found. These are due to sewage effluents containing human excreta. Nickel is present in amounts ranging from 290 to 1,300 parts per million in muds which are polluted with industrial waste. Investigations of conditions effecting the biological and chemical release of adsorbed or precipitated nutrients and toxicants from marine benthic environments are essential. The bottom sediments also serve as a reservoir into which these materials may be extracted from the water mass. They can also serve as the reservoir of carbonate materials which help to maintain the innate buffering system of marine waters. Thus, any consideration of the estuarine ecosystem must include full understanding of the relationship between the bottom sediments and the overlying water mass.

Air-Water Interface

The fourth major interface, that of the water and the atmosphere, frequently is ignored in investigations. These interfaces are characterized by surface films which are areas of concentration not only of surface active materials, but of bacteria and other microorganisms as well as inorganic particles of various kinds. These natural films should be distinguished from layers of oil

which are much thicker and possess different properties. They occur on the sea surface around all islands and along all continental shores and, hence, are characteristic of estuarine zones. They travel with the wind at speeds approaching the wind speed and can rapidly concentrate materials along shore lines, especially on a windward coast. These effects are very important in case of associated radioactive pollution, as well as bacterial pollution. Some of the surface active materials are of natural origin and are greatly increased by agents that kill marine organisms. Other film-forming materials result from oil spillage. The film, from whatever source, changes the transfer rate of gas through the water surface, the sinking rates of inorganic particles, and the distribution of small organisms. Research is required to better understand the origin, distribution, and importance of surface films.

SUMMARY

A. Baseline studies

1. Inventory biological, physical, and chemical characteristics.
2. Answer key management questions of habitat requirements (how much and what kind) for adequate numbers of plants and animals.
3. Studies of unpolluted estuaries are essential for comparative basis against which to measure changes.

B. Broad ecological studies

1. Expand baseline knowledge to provide understanding of estuarine ecosystems, the effects of pollution, and environmental changes.
2. Study the mechanisms and course of recovery of an area after halting pollution as well as methods of re-establishing a physically damaged estuarine ecosystem.
3. Develop techniques to determine and predict the effects of changes in the environment on the resources we want to utilize.
4. Develop better estuarine husbandry programs, augment aquaculture, and generally improve estuarine management.

C. Biological Studies

1. Determine food webs and trophic relationships
2. Determine life cycles and the relationships between estuarine residency and off-shore fisheries.
3. Determine what it is about the estuary that makes it so suitable as a nursery area and quantify habitat requirements for spawning and nursery function.

D. Water quality considerations

1. Determine water quality characteristics of receiving waters and develop a realistic program of water quality management.

2. Study the effects of combined wastes, i.e., multiple pollutants.
3. Ascertain water quality requirements for desired uses.
4. Develop water quality criteria for optimal beneficial use rather than minimum tolerable quality.

E. Natural variability

1. Determine the natural variability of the biotic populations as well as of the physical-chemical environment and water quality.
2. Learn to distinguish between the effects of natural variability and of man-induced alterations.

F. Interface Factors

1. Determine the amounts and quality of fresh water required to support the desired estuarine ecosystem.
2. Identify and understand the characteristics, the phenomena associated with, and the influence of the estuary-ocean and estuary-fresh water interfaces.
3. Identify and quantify the residual pollutants introduced by land drainage and their effects.
4. Determine the relationships of contiguous wetlands to estuarine ecosystems.
5. Determine exchanges between the bottom sediments and the overlying water mass.

6. Increase understanding of the origin, distribution and importance of surface films.
7. Determine exchanges between the atmosphere and the estuarine water mass.

It is evident that a fresh new approach to ecological research is necessary if we are to gain needed knowledge and understand estuarine ecosystems in time for it to be of value for management decisions. If the old patterns of investigations are followed, wherein detailed studies by many investigators are made on individual species, it is quite probable that answers will be unavailable in time to be of any real value in shaping decisions for the management of estuarine zones. A highly coordinated approach to this problem is needed. One approach would be to concentrate research in a number of centers where a high degree of proficiency exists, developing a system of coastal laboratories to satisfy both national and regional needs. Extramural research for the most part would probably be done under contract to assure appropriate direction in terms of national goals, bearing in mind, however, that this direction should take full advantage of consultation and advice from knowledgeable scientists and engineers from all segments of the industrial, academic and government communities.

SECTION 5. TOXICITY

All too often data required to interpret toxic conditions are obtained solely through field observations after the environment has been irreversibly changed and an ecological catastrophe has occurred. Predictions and management decisions based on this kind of information are poor at best. The only way that the knowledge needed by managers to cope with potentially toxic situations can be available in time to be useful is by having previously established tolerable levels of pollutants, developed through bioassay techniques, and appropriately extrapolated to natural conditions. Toxicity studies would be concerned not simply with levels at which a species could survive, but also at what levels it will reproduce to complete its life cycle without significant change. From such studies, criteria could be established much as they are for public health measures, but relevant to the organisms as well as to man. Only through such long-range programs can the desirable biologically productive aspects of estuaries be preserved and the other beneficial uses augmented.

SUBLETHAL EFFECTS

There is a growing awareness that, in the long term, the major concern should be for an understanding of sublethal chronic effects in order that realistic water quality criteria may be developed based upon the interrelationships within ecological systems. Much of the presently available data have been derived from acute toxicity tests on adults without adequate consideration of the chronic effects

upon the development of organisms and communities. There is an urgent need, therefore, for diversified programs to develop new indices of toxicity at the individual, the population and the community levels, with emphasis on long-term exposure at sublethal concentrations.

Food Chain Effects

The outright poisoning of various organisms is easily recognized. Perhaps an even more important problem is the effects of various toxicants present in concentrations which reduce the populations of food organisms to such a low level that they are inadequate for the forms depending on them as a food supply. For example, fish such as salmon, migrating downstream, will be feeding on their way to sea. If these young fish are feeding on a sub-adequate food supply, then they must be in a weakened condition for their subsequent journey in the ocean and, thus, be more susceptible to attack by predators and disease than they would be otherwise. Various kinds of pollution such as toxic materials or heated effluents could cause such results.

Another food food chain effect is the phenomenon of biological magnification. Biological magnification is an additional chronic effect of toxic pollutants (such as heavy metals, pesticides, radionuclides, bacteria, and viruses) which must be recognized and studied. Many animals, and especially shellfish such as the oyster, have the ability to remove from the environment and store in their tissues substances present at non-toxic levels in the surrounding water. This process

may continue until the body burden of the toxicant reaches such levels that the animal's death would result if the pollutant were released into the blood stream by physiological activity. This may occur, as in the case of chlorinated hydrocarbon pesticides (such as DDT and endrin) stored in fat depots, when the animals's food supply is restricted and the body fat is mobilized. The appearance of the toxicant in the blood stream causes the death of the animal. Equally disastrous is the mobilization of body fat to form sex products which may contain sufficiently high levels of the pollutant so that the normal development of the young is impossible.

The biological magnification and storage of toxic residues of polluting substances and microorganisms may have another serious after-effect. Herbivorous and carnivorous fish at lower trophic stages may gradually build up DDT residues without apparent ill effect. Carnivorous fish, mammals, and birds preying on these contaminated fish may be killed immediately or suffer irreparable damage because of the pesticide residue or infectious agent.

A great deal of work must be done to determine the significance of the phenomenon of biological magnification. We must develop techniques for predicting potential hazards before toxic material is introduced into the environment and economic noisens must be used so as to minimize the possibility of biological magnification.

BIOASSAY CRITERIA

Bioassay criteria are sorely needed to determine the effects of thermal, domestic, and industrial wastes. Synergistic effects of pollutants must also be known and understood. Once the tolerance limits of individual species for individual pollutants is known, the effects of combinations of various toxicants and physico-chemical water characteristics should be determined, since combined effects are often worse than the sum of individual effects.

The Need for Bioassay Procedures
and Field Testing

The ultimate goal should be the development of rapid, practical, and definitive bioassay procedures. These procedures should be designed for multi-parameter analysis in order to correlate the response to a variety of common pollutants and environmental variations. In this way, effective water quality criteria can be developed coupled with a capability for predicting biological effects. A major problem in the development of these practical bioassay procedures to determine the water quality requirements of estuarine and marine organisms is the lack of suitable testing methods. There is always the question about the realism of work done in a laboratory; that is to say, how truly results so derived reflect what takes place in nature. Test organisms in the

laboratory are certainly not confronted with the complex interacting factors which occur in the natural environment. Under natural conditions, there may be a rapid reduction in the concentration of a toxicant by precipitation, adsorption on soils and bottom materials, chemical decomposition, reactions with other substances in the water, absorption by microscopic organisms, removal by organisms, or biochemical degradation. Accumulation of toxicants in the food chain and ingestion of food organisms bearing relatively high concentration of these materials may increase the exposure to higher animals.

Laboratory findings on the safe levels of potential toxicants must be field tested under conditions wherein the organisms in question are exposed to all stresses occurring in the natural environment. When developed, tested, and evaluated, field studies can be used for simultaneously testing the entire community under natural conditions. Such studies integrate the effects of biological magnification; storage; passage through the food chain, accumulation in bottom materials, competition for food, cover, and living space; disease, parasites, and predators; synergism, antagonism, and the interaction of materials; and all other complicating factors present in the natural environment.

To be a truly useful management tool, a catalog should be developed indicating the tolerance levels of plant, animal, and bacterial estuarine species for the pollutants so commonly found in the

estuaries: sewage, heavy metals, industrial wastes, runoff from urban and agricultural areas, oils, and a host of other materials foreign to the estuarine environment.

SUMMARY

Wise management decisions require knowledge of the effects of potentially toxic substances as determined by long-range bioassay procedures extrapolated to natural conditions. Environmental levels of toxicants which do not inhibit any portion of the life cycle, food chain, behavior, or exert any detrimental sublethal effects must be determined.

SECTION 6. MICROBIOLOGY

Microbiological aspects must be considered in a special category because of their widespread and diversified influence. Bacteria serve to break down dead organic material and wastes into inorganic nutrients necessary for plant growth. These nutrients in moderation and in proper balance make possible the normal algal productivity which, in turn, supports all animal life. In excess or imbalance, these nutrients permit or encourage eutrophication, the accelerated superabundance of algae to nuisance conditions. Bacteria are responsible for causing foul odors, unacceptable bottom conditions, disgusting slimes that foul fishermen's nets, and depletion of dissolved oxygen in the water which drives out fish and other desirable organisms. Bacteria, protozoans, and viruses are extremely important as disease organisms, both to humans and to desirable estuarine plants and animals.

ALGAL GROWTH PROCESSES

As more and more studies determine that eutrophication is a major current or potential concern in our estuaries, it is imperative that we seek to understand the cause-effect relationships governing algal growth processes. Both field and laboratory studies

are required. The actual impact of nutrients on estuarine eutrophication problems must be understood. We must establish the major nutrient concentrations allowable in various estuaries based on watershed characteristics, influent stream concentrations, and the overall watershed management policies. An approach often overlooked on this topic is the complementary use of experimental studies and modeling techniques in which each is employed to direct the development of the other in the same way as computer analyses and test flights have interacted in the space program. Certainly, more knowledge will have to be developed about the rates and conditions under which organic material is mineralized by bacteria to the active chemical stage where it can be reincorporated into new plant material.

ECOLOGY AND ENVIRONMENTAL REQUIREMENTS OF MARINE BACTERIA

Detailed knowledge of the environmental requirements and ecological relationships of marine benthic bacteria and of attached algal forms as well as the free-living and more economically important marine species is necessary to insure that environmental changes allowed do not effect water-use at a point many biological steps removed from the initial effect. Studies of factors involved in natural population succession and natural fluctuations in populations of a single species and/or a community of species are required when it

becomes desirable to control these natural changes. It is certainly necessary to recognize them as factors affecting management of natural resources. It must be borne in mind that bacteria themselves are an exceedingly valuable prey species as well as is the phytoplankton whose development is made possible by the mineralization activity of bacteria.

The Use of Indicator Bacteria

In order to assess biological contamination and potential health hazards in estuaries, adequate bacterial assay techniques are necessary. The use of indicator bacteria, mainly fecal coliforms, is the major and most widely used detection system. Current water quality criteria for contact recreational waters place emphasis on fecal coliform data and consider this group to be a more realistic indicator than total coliforms of the presence of pathogenic microorganisms. It has been the practice to utilize techniques that are workable for fresh water systems. As a result, the widely accepted rapid MF (membrane filter) fecal coliform procedure is being used for salt water bacterial analyses. Only recently have attempts been made to assess and verify the reliability of such MF techniques for bacterial assay in salt water. Apparently, interferences and factors associated with the saline environment cause coliforms and pathogenic microorganisms to behave differently than when in fresh

water. These studies have revealed specific problems and indicate the need to develop information concerning behavior of these indicator bacteria in salt water. Examples of needed work include improved procedures for specificity and recovery of MF fecal coliforms, determination of growth characteristics of fecal coliforms, and establishment of whether the "after growth" phenomenon exists in estuaries; establishment of in situ survival patterns of fecal coliforms in various conditions of temperatures, salinity, and nutrient levels; establishment of the relationship between fecal coliforms and pathogens; and development of rapid detection systems and continuous bacteria assay devices to monitor shellfish waters and bathing beaches.

Pathogenic Bacteria

Recent studies have shown that Salmonella are more prevalent than once believed to be. Salmonella have been isolated from polluted estuarine waters on numerous occasions and have been isolated when low numbers of fecal coliforms were present. The Salmonella data, however, are qualitative and give no true indication of densities initially present in the water.

Because of the repeated demonstration of Salmonella in polluted estuaries and shellfish harvested from such waters, such organisms pose a serious potential human health hazard. Methodology for detection, identification, and quantitation of Salmonella are

essential for establishing the presence or absence of these pathogens. Associated needs are to develop a rapid detection system for quantifying and identifying Salmonella serotypes; determine the growth characteristics of Salmonella and establish whether multiplication occurs in the saline environment at various temperatures, salinities, and nutrient levels; develop in situ survival patterns to determine relative persistence in salt water and establish the relationship between Salmonella and the fecal coliform group of bacteria.

The fecal streptococci have provided supplementary data when the fecal origin of coliforms has been in question and when the recency of contamination had to be ascertained. Because of specific animal strains, such as Streptococcus bovis, and Streptococcus equinus, animal contamination can be detected and separated from human waste sources. However, as with fecal coliforms, data on the efficiency of detection and on the behavior of fecal streptococci in salt water are limited and need to be developed. Desirable investigations should involve increase in the specificity of recovery media; establishment of the various conditions of temperatures, salinity, and nutrient levels; in situ survival patterns of fecal streptococci, establishment of the relationship between fecal streptococci and Salmonella, and the development of rapid detection and identification systems amenable to continuous water quality monitoring.

Parallel studies should be done for other disease-causing organisms such as the viruses and microscopic organisms such as the viruses and microscopic organisms that produce toxicants such as Clostridium and Gonyaulax.

Another group of pathogens sorely in need of research and understanding are those which affect desirable estuarine organisms. Crabs in Chesapeake Bay have been known to suffer epidemics of viral diseases. Oysters in the Northeast have been subjected to, and nearly eliminated from large areas, by the disease MSX. A great deal of work must be done to determine the extent and variety of these disease-causing organisms and to develop control measures so that desirable crops might be maintained. The ability to protect economically important organisms is essential before aquaculture can be pursued on a profitable basis.

SUMMARY

1. The cause and effect relationships of nutrient supply, bacterial action, and algal growth processes must be better understood. Environmental conditions inducing and supporting nuisance eutrophication must be controlled.
2. Detailed knowledge of the environmental requirements and the ecology of estuarine bacteria should be developed.
3. More must be learned about coliform bacteria as indicators of pollution. Methodology appropriate for estuarine waters must be

made more definitive.

4. Methodology for detection, identification, and quantitation of Salmonella and other disease organisms must be developed. The persistence and transmission of disease organisms must be better understood and methods of control developed.
5. A great deal of work must be done to determine the extent and variety of organisms which cause disease in desirable organisms, and control measures developed.

SECTION 7. PHYSICS AND MATHEMATICS

The specific kinds of research that must be done within the physical and mathematical aspects of estuarine management fall generally into the broad categories of hydraulics, sedimentation, physical modification and structures, and physical and mathematical modeling.

HYDRAULICS

Scope

The briefest statement of what is needed in hydraulics is an understanding of the water dynamics of the estuary, including details of tidal and current regimes, an evaluation of the effects of river flow, rates of water exchange, characteristics of flushing, and all of the other phenomena related to the nature and behavior of the fluid portion of the estuarine zone.

Flow Characteristics

A starting point in understanding the hydraulics of an estuarine system would be an analysis of macroscopic flow and circulatory patterns including seasonal discharges from rivers, seasonal temperature inputs from rivers, density aspects (completely mixed versus stratified estuaries), tidal cycles, effects of wind stress, effects of unstream reservoir management, of flow quantity and quality, measurements of direction and magnitude of water masses, and of velocity relationships.

Flushing Characteristics

Closely related to a knowledge of the flow characteristics of an estuary is a more detailed knowledge of its flushing characteristics. It appears that we know very little about the true flushing time of many of the contaminating conservative materials which are in solution. We, of course, can make use of the freshwater-saltwater relationship to arrive at some estimate of flushing time, but, it is extremely doubtful whether information so derived applies to nutrients or such materials as pesticides or other non-conservative materials. Many of the nutrient chemicals become trapped in the biomass distributed throughout the estuarine zone and, thus, nutrients may not be flushed as would be predicted from a knowledge of the behavior of the water mass. The same thing can happen with pesticides. For example, studies on the Mississippi River tend to indicate that pesticides are complexed onto sediment particles which then settle to the bottom, resulting in a very high level of pesticides near where sediments build up and a fairly low level in other areas. In other words, in a bay or estuary, pesticides and other compounds may tend to be trapped on sludge or sediment particles and not be passed out into the ocean. This provides a reservoir of undesirable materials which, as discussed earlier, may become reintroduced into the water mass or the biotic compartments. These caveats notwithstanding, an accurate and quick way of determining flushing characteristics of

an estuary would still be extremely valuable. Adequate methods of quickly determining flushing are imperative before any other studies can be meaningfully undertaken, because all estuarine characteristics are regulated to some extent by flushing.

This approach leads naturally to a classification of estuaries by type describing flushing rates as a definition of salinity patterns, mixing rates, and extent of salt water intrusion. The true value of all this would be to develop predictive capability of estuary flushing which, in turn, will yield understanding of what will happen to introduced wastes and of the assimilative capacity of the receiving waters. Such predictions, if reliable, are important in an estuarial water quality management program. Further investigation of the feasibility of this should be encouraged.

Mixing and Transport Processes

Mixing and transport processes are important aspects of estuarine hydraulics. A considerable amount of research on diffusion and dispersion of wastes has been done and a body of knowledge appears in the literature. Many feel that research in these areas has generally fallen into two classes. It has either been too descriptive to permit the transfer of specific knowledge to other estuarine areas or it has consisted of a highly complex and idealized mathematical solution that

cannot be applied reliably to another estuarine area. Although the technology for predicting probable water quality effects in freshwater streams has advanced to the point where predictions can be made with some degree of reliability, the same circumstance does not exist for estuarine areas. Applied research to develop practical predictive methods is necessary in order that management agencies can approach water quality problems in a given estuary without first mounting a large-scale, expensive, and time consuming field investigation to define the assimilative capacity of the estuary through classical methods. Inputs into such a technique, of course, demand knowledge of the sources, characters, amounts, and time distribution of polluting discharges, including urban and agricultural land runoff as well as discrete sources.

At the other end of the estuary is the exchange with the ocean. The hydromechanical exchange which occurs between the estuary and the ocean is an extremely complex phenomenon about which little is known. This is a significant factor in the loss or retention of water quality constituents in the estuary and is related to all of the other discussion on hydraulics, sedimentation, and other physical aspects. All kinds of modeling activity require qualitative and quantitative data on ocean exchange, particularly in areas like Monterey Bay which have an ill-defined interface with the ocean.

Ground Water

Not to be overlooked in any investigation of the hydraulics of an estuary is an understanding of the ground water to surface water relationships, including sub-surface water discharges and salt intrusion. This calls for knowledge and quantitation of the chemical and physical characteristics of ground water and ground waterflow in the estuaries.

Engineering Controls on Water Movement

A natural sequence of an understanding of the hydraulics of an estuary would be the utilization of this knowledge in engineering controls on water movement. Apparently, little work has been done to take advantage of the energy contained in the moving water for the purpose of flushing and bottom-cleansing action. The research question would be: "Is it possible to design engineering works that utilize water movements, including, tidal action for estuarial flushing and bottom-cleansing?" This question warrants investigation.

SEDIMENTATION

Substantial pollution problems in estuaries result from the effects of benthic deposits. These in most estuaries represent a heritage of pollutorial materials brought in over the years by streams, outfalls, and sewer overflows discharging into the

estuaries. Research is called for to provide an adequate knowledge of how to prevent and control the effects of this material. Such research should be directed to methods for determining the origin of bottom deposits, their physical characterization, acceptable measurement techniques, transport phenomena, effect on the ecology of the system, and the die-away and fate of these materials. The ultimate question is, of course, how to prevent undesirable sedimentation from increasing and how to get rid of existing deposits economically and efficiently. It may well be that practical solutions to this problem will not be forthcoming. In this case, dependable information on the natural die-away characteristics of bottom deposits would be very desirable. Studies should be made toward developing biological systems or marine sludges capable of degrading industrial and domestic wastes discharged into marine waters.

Dredging and Spoil

The pollutional effects resulting from dredging operations is part of the problem of control of undesirable bottom deposits. Conceivably, dredging may be offered as the method of choice for removing objectionable bottom deposits; thus, the disposal of such dredgings is a matter of importance and additional research on its handling and disposition should be pursued. Much of the spoil from commercial and navigational dredging operations is deposited in the low-lying marsh areas. As the value of wetlands

increases, other areas for spoil disposal must be developed.

One possibility is the use of spoil for reclaiming certain areas. If this is possible, the structural properties of the spoil must be improved so that it will stabilize when placed in these areas. Methods, procedures, and additives which would help to stabilize these materials should be investigated.

Offshore and Near-shore Dumping

Much material is dumped offshore. Offshore dumping is a method of disposal for both solid and liquid materials in the open sea. It includes discharge to coastal waters, both within and outside the territorial waters of the United States. In shallow areas, much of this material is subject to complicated energy forces which vary from day to day. Wind forces appear to exert stronger influences in shallow areas than are generally encountered in deeper waters, perhaps further inshore. Because of this, much more information is needed on wind, tide current, and other offshore or onshore hydraulic effects before the fate of dumped materials can be accurately predicted and a program of disposal wisely managed.

Sources and Rates of Sedimentation

We need to develop new and improved ways of measuring sedimentation rates, including model studies to evaluate methods of

curtailing sediment deposition and more effective and beneficial means of sediment removal and disposal. We need to know what levels of sedimentation rates are tolerated by organisms, and what levels are damaging to desirable organisms. Since organisms are affected differentially by sedimentation processes, rates of change would have to be studied specifically for key individual species. Another source of sedimentation is the flocculation of colloidal suspensions of materials entering sea water with resulting deposition at the salt water interface. In order to avoid the problems of silting and deposition of sediments within lagoons or in channels, we must know more about rates of filling, mechanisms of clay and silt deposition, and concentration of organic debris and pollutants in sediments and in marsh vegetation.

STRUCTURES AND PHYSICAL MODIFICATIONS

It is well known that structures and physical modifications within the estuary may change the hydraulic, biological, sedimentological, and many of the other characteristics of the area. While it is desirable to reduce our activities of this nature, it is probable that pressures of population and economics will force continuing estuarine construction. As construction takes place within coastal areas, many changes will occur in the estuaries. The effects of these changes should be known before constructing industrial plants, homes, highways, or airports; dredging canals

or draining marshes. This sort of information is especially essential if a meaningful permit review system is to be instituted and maintained. Physical alterations of estuarine and coastal zones by dredging, filling, bulkhead construction, ditching for mosquito control, and construction of new marsh requires investigative work that would determine the effects on water quality, the effects on biological life, and the effects on hydraulics. Special attention should be paid in the development of new harbors to retain or enhance the structural components necessary for those organisms requiring protected waters for their reproductive activities.

PHYSICAL AND MATHEMATICAL MODELING

Estuarine systems will continue to receive heavy utilization for all types of man's activities. Population trends indicate that coastal areas are attracting a disproportionate percentage of our expanding populations. With this trend we also have the industrial activities necessary to support the economy. At the present time, we can not predict accurately the assimilative capacity of estuarine systems, nor can we predict the degree of degradation that will result from the engineering projects proposed as necessary to provide the supporting services for the social and industrial structure.

The solution to these problems might well be approached by simulation techniques. It is urged that efforts be intensified to provide physical and mathematical models of estuarine systems which are being subjected to population and industrial pressures. Experience indicates that when such models are available they are used extensively by Federal, State, and industrial interests to provide guidance for the proper management of estuarine resources.

Two systems of simulation or modeling are normally considered: the physical model and the mathematical model. Probably the true utility of the physical model has not yet been established. The development of such a model for an important estuary has a great deal of appeal for teaching, demonstration, and to some extent for control purposes in addition to the predictive capability rendered. There is no question that advantages of such a model are clear for teaching and demonstration. What is not as clear is the extent to which such physical models may be employed to predict and solve problems of pollution, sedimentation, physical modification and structures in the estuary.

The use of mathematical models to simulate the dynamic phenomenon of the estuary has only recently been subjected to rigorous examination. Research in this area should be encouraged. A complete appraisal of the relative merits of physical and

mathematical models should be made. The advantages and disadvantages of each type of model for different purpose studies should be fully delineated.

Finally, to complete the objective of optimally maintaining or enhancing estuarine water quality, management models need to be developed and demonstrated which will determine the optimum control strategy drawing upon all of the aforementioned quality control techniques.

Physical Models

Physical models can be considered essentially as three types. One type, and perhaps most dramatic and most expensive, is one in which the complete water mass and its basin under consideration are constructed in a scale keeping with that of the natural configuration and in which the natural forces working on that basin can be applied and varied at will. This sort of model is used effectively by the Corps of Engineers and a great deal of excellent information has been derived from them. Of all of the possible modeling alternatives, this is probably the most useful and, hence, should be the most widely applied for each of the major estuaries and minor estuaries of special interest in the country. Research is needed to obtain similarly reliable information without going through the expense and time required to construct these.

Another kind of model is one in which a specific machine is developed and constructed which will reproduce certain of the natural phenomena in the laboratory. These normally are flumes, wave basins, or some other single-phenomenon simulating device.

Utilizing these laboratory simulation devices, the following studies should be conducted.

(a) Large movable flume tests using the typical range of littoral drift material (sand and shell) found along the coast are essential to verify or modify the various sediment transport formulas; determine lower and upper limits for application of such formulas; improve definition of roughness coefficient with changing geometry, sand riffles, and dunes; and determine definite usable values of entrainment functions and tractive force (bottom shear stress).

(b) Utilizing three dimensional wave basins, studies should be done to help yield first approximation designs of inlet and inlet model studies to help locate and determine the size and shape of jetties; determine effects of winds and waves on tidal flow, erosion, siltation, sediment transport, and sand by-passing; and check the effects of density currents

on flow and sediment transport. Information of this kind allows a revision and refinement of inlet designs. Studies should be done to determine the effects of changes in tidal differentials, changes in circulation and efficiency of mixing, and structural modifications for controlled water releases, for restoring and improving internal circulation, for enhanced fishery environments, and for augmented assimilation of treated return flows.

A third method of physical modeling is to use a portion of an actual estuary. Such model estuaries have the dual advantage of providing both a natural environment and a means of control over many variable factors. Model facilities are built outdoors in a relatively unpolluted bay near its mouth. Proximity to the open ocean assures waters with salinity values sufficiently high to support a wide variety of organisms the year around. Adjustment of salinities is accomplished by adding fresh water from some nearby source such as a stream. Renewal of the water in the facility is by natural tidal action through properly designed tide gates. Currents of varying velocities are maintained by the use of recirculating pumps or paddle wheels. Various types of bottom substrates are provided to meet the requirements of a wide variety of benthic organisms.

Studies using the above-described model estuary facilities provide a controlled natural environment for determining realistically the

water quality requirements of estuarine organisms. A corollary objective is to determine how various pollutants affect the water quality requirements of estuarine organisms and ultimately their productivity. It is apparent that properly conducted, comprehensive studies of this type would take a great deal of time, effort, and money. Significant economies can be achieved in all of the latter if the model facilities would be successfully minaturized. Other advantages to the use of miniaturized model estuaries is greater flexibility in the study of variable factors and a substantial reduction in the quantity of pollutants required for testing. A basic requirement for such model facilities is the ability to maintain on a self-sustaining basis the biota representative of the parent bay. Accordingly, the initial phase of study would be concerned with developing the various size model estuaries to determine the degree of miniaturization possible without sacrificing the basic requirements.

Development and use of model estuaries would be especially suited for supplying much of the water quality information identified by the National Technical Advisory Committee on water quality requirements. It also would serve as a bridge between laboratory and field studies and, as such, assume a priority role as a research need.

Special Values of Physical Modeling

The value of physical models of the tidal and estuarine environ-

ment lies in their adaptability of use to study a wide spectrum of problems. Some of the most significant are: flooding due to hurricane surges; efficiency of tidal mixing and the resulting salinity distributions; diffusion, dispersion, and flushing of waste discharges (sewage, chemical, thermal, etc.) in bays and estuaries along the coast; shoaling and erosion in bays, navigation channels, coastal inlets, etc., due to deposition of dredging spoil, and river and coastal sediment movements; improvement and verification of designs for navigation channels, estuarine coastal structures, tidal inlets, jetties, etc. They provide a means of determining in advance the effects of channel deepening, jetty extension and construction of new jetties, the effects of land fills and destruction of parts of tidal flats, and the effects

such projects would have on the total physical picture of an estuary.

Mathematical Models

Mathematical models have the advantage of requiring little expensive construction and maintenance. They are basically expansions of equations of state of various physico-chemical phenomena in a water course. They theoretically should allow for proper consideration of all of the variables, when known. Simulation is done through computer techniques and, hence, has the advantage of speed and flexibility. The drawback in the application of these

models is the need to know, understand, and quantify every one of the factors of the system being modeled. In the absence of any portion of this kind of information, assumptions must be made. The more complicated a system, the greater the area of ignorance, the more assumptions must be made, and the less confidence can be placed in the results. To date, effective mathematical modeling activities have been applied for some of the more important water quality parameters, such as dissolved oxygen, in some of the simpler estuarine systems. The research need here is to overcome all of the difficulties and satisfy the drawbacks just stated. Obviously, this approach should be most valuable if and when perfected.

SUMMARY

A. Hydraulics

1. Develop complete understanding of the water dynamics of the estuary, including details of tidal and current regimes, evaluations of the effects of river flows, rates of water exchange, and characteristics of flushing.
2. Determine the source, activity, and fate of both conservative (e.g., salt) and non-conservative (e.g., pesticides, nutrients) materials in the estuary.
3. Classify estuaries according to flushing characteristics in order to enhance our predictive capability for waste

disposal purposes.

4. Increase our knowledge of mixing and transport processes at the various interfaces and within the estuarine water mass itself.
5. Determine the significance of ground water inputs to the estuary.
6. Develop engineering ability to use water movements, including tidal action for estuarial flushing and bottom cleansing.

B. Sedimentation

1. A wide range of research is required to provide an adequate knowledge of how to prevent and control the effects of pollutional benthic deposits.
2. Develop methods for mitigating the estuarine damage due to dredging activity and improve spoil disposal practices.
3. Increase knowledge of the effects of offshore and nearshore dumping.
4. Increase knowledge of the sources and rates of sedimentation and of the effects of sedimentation on the ecosystem.

C. Structures and physical modifications

1. Determine the effects of structures and physical modifications

on the hydraulic, biological, and sedimentological characteristics of the estuarine zone.

D. Physical and mathematical modeling

1. Develop physical and mathematical modeling techniques to the level of yielding reliable predictive capability and to determine optimum control strategies for estuarine management.
2. Develop more effective and less expensive simulation capability.

SECTION 8. SOCIOECONOMIC FACTORS

Perhaps the most important area in need of research and study is that of socioeconomic factors broadly grouped under planning, economics, and law. Unlike the previous discussions on study needs concerning technical subjects, the research and study needs to supply information necessary for wise planning is more difficult to define in terms of separable projects. Certainly, the guidelines are more diffuse and the areas of overlap are greater, for here we are dealing with human factors, with intangible values, with aesthetics, and with recreational satisfactions. Further, it is in this area where we must come to grips with the conflicts existing in estuarine use and abuse. It is in this area where the hard questions subject to litigation arise, for having developed all of the information required to support technical management of the estuaries, we must now amalgamate this knowledge with a comprehensive plan of management which will provide for a program of optimum beneficial action.

PLANNING

By definition, the need here is to establish comprehensive long-range use plans for each estuary, including industrial and recreational areas as well as wildlife and fishery preserves. A necessary balance between preservation, study, multiple use, and

development of estuarine areas must be achieved in this planning, and hence, we must also determine methods for developing desirable uses in areas where none exist now. Because one of the greatest unrealized values of the Nation's estuaries will be for recreational purposes, there is a need to identify the optimum recreational carrying capacities for the various estuarine areas.

It is necessary to increase capabilities for estuarine resources appraisal, coordination, and planning to assure that research findings are used to maximum advantage and to assure that all the possible uses and all the possible available resources will receive optimum consideration in the multiple use concept of planning, development, and management of the estuarine zone. Methods must be developed which will enable the planning agency to answer questions that relate the cost of treatment applied to waste to the value of benefits attainable or resulting from such treatment. While the costs of waste treatments are reasonably well known, the value of the benefits that would result frequently are less tangible and their quantification requires first the development of an acceptable methodology for making such a study.

There is no doubt that increasing pressure will be brought on estuary planning agencies to beautify shore front land. Landscape architects and others trained in land development should do research towards developing planning criteria.

And, as is required in all management schemes, research must be done which leads up to the development of alternative master plans for the long term uses of estuarine and land related zones.

ECONOMICS

The economics of conservation and development, and the planned utilization of estuarine resources must consider all aspects of the ecosystem as well as human factors. Past and present techniques have seldom defined the beneficial uses of the resource adequately. Research is needed to develop techniques which permit the consideration of social, economic, and aesthetic factors as well as technological factors. Further development of decision models which can "quantify" these factors on a design or operational basis is a high priority item in a list of needed research. A central problem of estuarine resource management is unquestionably the matter of economic evaluation and resource allocation. It is ironic that even though management activity is specifically designed to add to the sum total of human satisfactions and benefits, it is probably the most mis-handled aspect of long term resource planning.

Estuarine Resource Evaluation

To define the economic value of the estuaries of the country would require detailed studies which, while under way, are not complete. It is possible, however, to project what the loss of the

estuarine areas would mean and it may be possible to apportion the increased value of restored or preserved estuaries on the basis of current patterns of usage and importance to our society. It is certain that whatever value may be placed upon the estuaries today, the value of estuaries can only be predicted to increase in the future.

We need to develop a sound basis for determining the economic and social benefits from estuarine areas and their living resources, both in terms of tangible values and their intangible returns to society. Land-water use studies to determine the real value of the estuaries for commercial and sport fisheries, recreation, navigation, and other commercial and industrial uses probably can be quantified even though there are no thorough statistics developed to document the exact value of the millions of acres of bays, estuaries, and coastlines near these estuaries.

For example, in southern California the loss of the estuaries would destroy the major resource currently available to the bait fishing industry. It would result in the extirpation of those fishes which require the estuaries during their life cycle, such as the striped bass and the croaker. It would result in the loss of a habitat for migratory water fowl and it would result in the loss of an important area for public recreation and aesthetic enjoyment. Recreation includes fishing, swimming, boating, and

just being by the water. Aesthetic enjoyment includes the pleasure of watching persons and animals living in their environment of the moment as well as the natural beauty of the estuary itself. We would lose the type habitat required as an example of the estuarine ecosystem for the education of our students as well as the opportunity to delve into the mysteries of life in this area through research. We would lose the example of the zone where it is most likely that animals left the sea to roam the land.

The estuaries are valuable, not only for their biological resources, for recreation, commercial harvesting of fish and shellfish, education, and research, but also as open spaces and opportunities for further development such as placing still another road, a marina, housing, plant sites, highways, or anything for which raw land is required, or for siting power plants or any other facility for which large amounts of cooling waters are required. The current trend is to convert the natural resource of the estuary to some other use with the elimination of all other options or alternative uses.

Research and study then is needed in techniques of measuring estuarine utility which could result in added productivity of the national economy by providing standards to optimize economic consequences of estuarine resource activities. Additionally, or alternatively, since it is likely that the development of

realistic evaluation procedures in this difficult area will require generations of research, recognition of marginal concepts and extra market utility in the context of risk and uncertainty would be of immense value to management policy and program formulation.

Pollution Control

In the specific area of water pollution control, studies should be made on the development of a better information system on the capitalization of in-place pollution abatement facilities. Adequate reporting of investment data exists only for the period from 1952 to the present, and there is little in the way of reliable depreciation information relating to sewers and wastes treatment facilities. Development of historical investment and depreciation levels would be useful in the development of national investment policies informed by an adequate awareness of capital requirements.

There is a requirement for research into the effectiveness of the various pollution abatement strategies. Comparative evaluation of results of the several program emphases, i.e., various controlling jurisdictions, consequences in terms of financial outlays, water quality preservation or degradation, water utilization constraints, would be useful in forming least cost national and state-controlled programs in the future.

Related to this is research into the influence of water availability and public-policy regarding water use and pollution control on industrial location decisions. There is evidence that separate industrial categories are affected by and react to a single set of water conditions in different fashions, but no comprehensive survey of response to conditions has been conducted at this time.

There are a large number of conditions where controls must be developed to deal with diffuse pollutorial influences of natural runoff (siltation, water-borne pesticides, concentrated urban runoff, etc.) and where costs have been inadequately examined or are unknown. Such cost data are essential to formulation of meaningful abatement programs and their development should provide a number of research projects. In general, however, these kinds of information requirements cannot be satisfied by economists alone, since they require technical determinations demanding the skill of hydrologists, biologists, engineers, and others.

Economic Planning Units

One of the most immediate needs is for the delineation of suitable economic planning units for comprehensive estuarine management. What is the minimum area of the estuarine resource that must be incorporated into a system before it can be managed effectively? If suitable economic planning units can be delineated and the

economic research can begin, then these management units can be modified as knowledge of other factors - hydrology, ecology, geology - becomes available.

LAW

As in the area of economics and planning, it is difficult to conceptualize the research and study needs involved with legal aspects of estuarine management in the same framework as that of the technical questions. Notwithstanding, a great deal of work must be done if we are to answer the questions having legal overtones in the Nation's estuaries.

There is a lack of clearly defined jurisdiction for the management of the Nation's estuaries. In terms of conventional legal categories, the rights of competing parties to resources which the estuary supports must be determined. Who owns the shoreline and the bed of the various estuaries? What special rights does the law give to private owners of land abutting the estuary? What rights does the law give all private individuals in estuarine resources? What is the difference between the rights to flowing waters, to tidal waters, and to marsh areas? What are the constitutional and territorial limitations on the regulatory powers of the State, the municipalities, and the Federal Government? This brings us to the need to examine and study institutional

barriers that prevent sound and equitable management and utilization of estuarine resources, to determine whether they can be removed. We need to promote new institutional arrangements to provide a nation-wide protective mantle for estuaries. Studies of State and local government, law, and policies as they pertain to ownership, planning, zoning, and land and water use must be made. Model legislation for the desired results must be developed.

There is the whole new question of the legal aspects of offshore waters that has been introduced by increased offshore dumping and long outfalls having effects beyond territorial limits, as well as the commercial aspects of fishing, oil development, mining, and other resources exploitation. Concentrated research into the means for local control of dumps outside the continental United States needs to be initiated and completed. While certain controls can be exercised at the loading points and during transport of the materials within continental waters, there is a serious question as to whether any legal controls can be exercised by State or Federal authorities over dumps outside the continental United States. Legal control methods must be developed quickly and international ramifications must be fully explored.

SUMMARY

A. Planning

1. Planners need information concerning human factors to

amalgamate with technical knowledge in order to develop a comprehensive plan of estuarine management which will provide for a program of optimal beneficial action.

2. Develop capabilities for estuarine resource identification, evaluation, and allocation.
3. Develop planning criteria for estuarine use.
4. Develop alternative master plans for long term estuarine uses.

B. Economics

1. Develop techniques for quantification of social, economic, and aesthetic factors along with technological factors which permit the use of decision models.
2. Evaluate all aspects of the estuarine resource and determine economic and social benefits and costs.
3. Determine the costs of in-place pollution abatement facilities.
4. Evaluate the effectiveness of the various pollution abatement strategies and formulate optimum beneficial national and State controlled programs.

5. Determine the importance of water quality and quantity and pollution control requirements on categories of users.
6. Delineate suitable economic planning units.

C. Law

1. Define legal jurisdictions for management purposes.
2. Define the rights and responsibilities of parties competing for estuarine resources.
3. Study State, Federal, and local government law and policies as they pertain to estuarine ownership, planning, zoning; and land and water use.
4. Develop model legislation for estuarine development, study, use, and preservation.
5. Determine the legal aspects of offshore dumping and outfalls as well as of offshore fishing, oil development, mining, and other resource exploitation.

SECTION 9. ANCILLARY RESEARCH AND STUDY NEEDS

There is a considerable need for knowledge which, while not in direct support of a system of technical estuarine management, is a significant part of the overall research and study program needed. These might be considered as needs of researchers and include environmental monitoring and surveillance, methodology (both laboratory and field), data processing, training, and estuarine zone laboratories.

MONITORING

There is a well recognized need for routinely monitoring the estuarine environment to complete and maintain the data base discussed earlier. A continuing program of environmental surveillance supplies the information needed to determine water quality conditions and the effectiveness of water pollution control activities. Surveillance also indicates the location, nature, and severity of pollution problems and is necessary to support legal and administrative actions to abate pollution and other destruction of the estuarine resource.

All of the values of an adequate data base for planning and managing the estuarine resource also accrue to an effective system of monitoring. Effective monitoring of marine and estuarine waters requires a continuing series of synoptic measurements at strategic locations. It will require an approach based upon adequate knowledge of the ecology involved and an understanding of the related physical, chemical, and geological processes.

Instrumentation

Field investigation and research in estuarine and near shore areas is extremely expensive in terms of manpower, time, and equipment commitments, thus, research to advance the state-of-the-art of surveillance and monitoring is necessary in order that information essential for management decisions can be obtained at less cost and in an expeditious manner. Instrumentation must be developed which will simplify data collection, will be reliable, and will require little maintenance. With the technological advancement in data acquisition capabilities such as remote telemetering systems, it is now possible to continuously record pertinent environmental parameters for extended time periods. In the recent past, man-hour requirements made such intensive data acquisition impossible, thereby excusing our present inability to distinguish man-made alterations of estuarine biota from natural fluctuations. However, we can no longer use this excuse. We must initiate intensive long-term estuarine monitoring programs that reflect existing capability in remote telemetering systems. Although the equipment price tag is high, it is cheaper in the long run than any other method and we can no longer afford not to develop this approach. A valuable system would be one which would warn directly of variations in monitored parameters which exceed previously determined limits. This would allow a biological survey to assess immediate and/or delayed effects on the biota from natural environmental fluctuations.

Positioning Data Collection Stations

Another need is in positioning data collection stations. In order to assure information relative to our research needs, the selection of monitoring sites for data collection must be as carefully selected as sampling sites for current methods of environmental analysis.

While it is recognized that intensive monitoring systems cannot be deployed in every estuary or coastal area of the United States, all major geographic and ecological zones should be covered. The development of buoy, barge, or other types of field stations offer a basis for the placing of monitoring systems.

Long Term Synoptic Monitoring

Many short-term (2 to 4 years) baseline ecological studies have been completed. Their results most frequently resemble a disjointed mosaic when synthesis for practical application is attempted. One of the major causes for a lack of unity among such studies is the "atypical year" or the "atypical area" syndrome which in essence is an admission that not enough detailed environmental data were taken before, during, or after such surveys to pin-point the effort in "ecological time" or "ecological space." Long-term synoptic monitoring will identify and satisfy many of the knowledge gaps that must be filled if there is to be any hope for coordinating and synthesizing results of estuarine research in the future.

Water Quality Criteria

Detailed, open-ended, continuous monitoring of whatever environmental parameters are recognized as requirements for, or potential toxicants to, aquatic life and for which appropriate technological capability exists, is necessary so that natural variation may be intelligently incorporated into the establishment of water quality criteria and the most productive use can be made of our coastal resources. Existing computer capability allows for selective data storage and reduction so that long-term trends, such as the saline encroachment of the Patuxent River, could be documented and a biological relationship established.

The major geographic and ecological areas of the United States should be monitored in a manner that is coordinated with research interests. Monitoring capability for future enforcement should be standardized and developed as a function of the research upon which enforcement needs will be based.

We have just begun to scratch the surface in the area of enforcing water quality standards by monitoring the aquatic system itself. Substantial research needs to be carried out in both the instrumentation and in the methodology of using instrumentation so that we can achieve a capability of enforcing water quality standards.

ANALYTICAL METHODS

Measurement and interpretation of water quality in the marine environment is a complex problem and is quite different from that encountered in the freshwater environment. Background values of organic and inorganic constituents are for the most part much higher than those encountered in freshwater. In addition, they are constantly changing with respect to depth, location, and time. Estuarine analytical methods frequently are more difficult technically because of the interferences encountered in analyzing specific constituents. Even after values are determined, the interpretation of these values frequently is difficult. Some wastes that remain dispersed or dissolved in freshwater are concentrated in ocean waters because of precipitation or by wave foaming. Marine waters at times have a high concentration of plankton and other forms which contribute to high natural organic carbon content; measures of BOD, COD, or total organic carbon as indicators of pollution are extremely difficult to interpret under these conditions. Research on analytical methods to resolve these and other problems should receive a high priority. The emphasis of such research should not be limited merely to chemical considerations but should incorporate the elements of significance and interpretation. Encouragement and opportunity should be provided for the development of new sampling and measurement methods for marine pollutants ranging from oil, pesticides, herbicides, and radioactive materials to

ordinary sewage. Increase as well as decrease in concentration of these materials can be rapid. The emphasis, therefore, should be on the development of rapid simple methods inexpensive enough for practical use.

Methodology is required for describing estuarine ecosystems. It has been pointed out that there is a need for conducting studies on an ecosystem basis. Even today, comprehensive ecological studies of estuaries are uncommon, and most of these are of limited scope. In order to enhance our progress it is necessary to greatly improve biological data collection systems. Techniques must be developed which will develop more significant knowledge with simpler, faster, and more reliable sampling and analytical techniques. Aerial reconnaissance of vegetation, distribution and abundance and in situ measurements of chlorophyll (a measure of standing crop) using a continuous recording fluormeter are examples of promising possibilities.

DATA PROCESSING

Scientific data describing the various estuarine systems has been collected for many years. Regrettably, this information rarely is put into a form in which it is generally available and useful for geographic areas beyond that in which the study was done. A specific need of research workers is for conventionalized methods of observation and data recording to be made and a central exchange where such information might be inserted and extracted by workers of all disciplines from all areas of the country. Such a system would rapidly

become an encyclopedic form of inventory. A great deal of thought and work must be devoted to the formulation of this system and for the development of a program to manage this system. Studies which have been conducted for specific purposes in specific areas should be integrated into a larger mass of information and made generally available. This system would serve not only researchers, but would also be an integral part of the information needed for planning, funding, and managing estuarine areas.

A second area of need in data processing is increased emphasis on correlating the collection of physical, chemical, and biological data in estuaries. For purposes of water quality management, descriptive data in one of these categories is essentially useless without comparable information in the other two. A critical core of data (including temperature, dissolved oxygen, salinity and pH profiles, chlorophylls, current velocities, bottom sediment, characterization, transparency, total seston, dissolved carbon, etc.) should be identified as commonly needed in all ecological studies of estuaries. Federal and federally sponsored researchers should be required to collect this data at reasonable time intervals during the course of all estuarine studies. Standard data processing techniques should be established and copies of information received should be collected in a central data storage bank.

If these two suggested approaches to data collection and data management are followed, the benefit to be derived by all estuarine workers will repay many times over the extra effort and nuisance required to supply a central source with duplicate copies of data.

TRAINING

The success of a national estuarine research program will to a very great extent depend on the availability of well trained and imaginative manpower that can implement national goals. Modern approaches to estuarine research will require more people on laboratory staffs with inter-disciplinary training in quantitative ecology and resource management. A program should be initiated to encourage scientists in a given discipline to undertake studies related to estuarine management. Economists should be encouraged to acquire a basic understanding of hydrology, ecology, and law. Engineers should be encouraged to study economics and ecology. Laboratories must now pursue comprehensive programs combining many disciplines if we are to expect to manage our coastal resources and their environments effectively. This approach requires a staff which most laboratories cannot acquire without additional support. Small laboratories should consider combining with larger laboratories, at least by using computer links which could coordinate programs. Training grants or contracts to academic institutions for studies by individuals in

different fields related to estuarine management will materially fill the present gap. Research must be fully coordinated with management needs and river basin activities to assure optimum application for all resources.

ESTUARINE ZONE LABORATORIES

The best way to provide the analysis, research, and development needed for a rational approach to the proper management and utilization of the estuarine and coastal zone would be to establish and designate multidisciplinary laboratories with area and regional interests. While most research and development analyses must be directed to regional and local coastal zones components, there are clear national requirements which have been imposed on agencies of the Federal Government. Consequently, laboratories must be maintained both by Federal Government and by institutions capable of meeting regional and local needs. This would call for estuarine laboratories and regional estuarine laboratories.

Federal estuarine laboratories would conduct research necessary to the implementation of Federal missions and, in addition, could provide certain facilities for common use in the areas they serve. Regional estuarine laboratories conduct research, analysis, and development specifically related to the coastal zones of their region and would serve as scientific and technical advisors to coastal zone authorities and appropriate State agencies.

The establishment of these laboratories would (a) demonstrate the Federal Government's recognition of the clear interest of the State Government in many matters relating to estuarine management and its recognition that it is in the interest of the national well-being that appropriate State authorities have as much technically competent judgment as possible to base their decisions, (b) create technical organizations to give adequate research and technological support to the federal decision-making process as it relates to estuarine matters, (c) recognize through Federal action the need to support regional estuarine laboratories which can conduct a vigorous research program, develop the technology for the effect of utilization of the coastal zone, and assume responsibility for training the necessary scientists, engineers, and others needed for estuarine management.

SUMMARY

A. Monitoring

- (1) Routine monitoring and surveillance of the estuarine environment should be pursued.
- (2) Instrumentation and techniques should be developed to simplify data collection, increase reliability, and reduce costs and time required.
- (3) Automatic remote telemetering should be increased and improved.

(4) Monitoring is necessary to satisfy many of the base-line data gaps discussed earlier.

(5) Monitoring systems should be coordinated with each other.

(6) Monitoring plays a key role in enforcing water quality standards.

B. Analytical Methods

(1) Sampling techniques must be simplified and improved.

(2) Methodology must be developed to simplify the interpretation and correlation of collected data.

C. Data Processing

(1) Data processing must be conventionalized and central data exchanges established.

D. Training

(1) Interdisciplinary training of estuarine workers is required.

(2) Training institutions should increase coordination to optimize their activities.

(3) Training should reflect the needs of estuarine management.

E. Estuarine Laboratories

(1) Federal estuarine laboratories should be established to conduct research necessary to the implementation of Federal missions.

(2) Regional estuarine laboratories should be established to conduct research specifically related to the estuarine zones of their regions, and to serve as technical and scientific advisors to appropriate State agencies.

SECTION 10. SPECIFIC RESEARCH PROGRAMS

Research is conducted in an estuary, bay, or coastal zone usually for the solution of a specific problem or for understanding natural phenomena. Elsewhere in this report, the importance of baseline studies has been stressed, but in addition to this, there must be approaches to understanding and solving specific problems in specific estuaries. The purpose of this Section is to present three research and study programs that have been performed or are in progress. This illustration by example demonstrates the way in which knowledge is developed to meet specific needs of technical management and, in turn, comprehensive management of the estuarine zone. In this Section, a baseline study originally designed for Biscayne Bay, Florida, but applicable to virtually any estuarine zone will be presented. The second example is a discussion of a study of the Kaneohe Bay estuary in Hawaii designed as a preliminary study prior to its increased use for sewage disposal, i.e., a "before" study with a specific stress in mind. The third specific research program is a proposal for re-establishing a desirable ecosystem in an estuary after damage has occurred and the source of damage has been removed. There will be many similarities in each of these studies, indicating that there is a basic fund of knowledge necessary regardless of the purpose of a research activity in an estuarine zone. Each of these proposals demonstrates the necessity of considering any estuarine zone in the context of a complete system.

BISCAYNE BAY, FLORIDA: A BASELINE STUDY FOR ESTUARINE POLLUTION

The purpose of this Study, designed as a long-term program for Biscayne Bay, Florida, is to develop the factual knowledge necessary for the optimum management of that estuarine resource. As in most of this Nation's important estuaries, man's activities already have had an effect. There is no pretension that we are dealing with a pristine ecosystem. Note also that this plan recognizes the importance of the legal and economic aspects that exist in real-world resource allocation and management. It does not attempt to satisfy the basic need for long range planning, nor does it specifically identify goals. It does, however, pose the questions that will supply quantified alternatives from which goals may be selected and plans formulated.

This model baseline study, thus, applicable to virtually every estuarine zone in the country and is, in fact, practically a prerequisite to the elucidation of specific plans for management and development.

1. Surveys to identify existing pollution in the estuary and in tributary streams
 - A. Literature survey of existing knowledge
 - B. Field studies to identify and measure the amount and seasonal occurrence of pollutants
 1. Chemical pollutants
 - a. Organic
 - i. economic poisons, e.g., herbicides, pesticides
 - ii. detergents
 - iii. oils and solvents from industry
 - b. Inorganic
 - i. metal ions
 - ii. substances that alter the acid-base balance of the estuary
 2. Sewage and waste discharge pollutants
 - a. excess plant nutrients
 - b. pathogens, e.g., bacteria, viruses, parasites
 - c. solid wastes that increase turbidity, form sludge beds, or settle out to cover over the bottom
 3. Fresh water

4. Heated discharges
 5. Air-borne pollutants
- II. Continuous monitoring of significant pollution, as identified by studies above
 - III. Identification of sources of pollution. This requires industrial and domestic waste inventories, evaluation of non-point source pollution such as urban street run-off, erosion, agricultural run-off, and irrigation return flows, as well as domestic sewage and industrial discharges. Pollution from vessels, oil discharges, and accidents involving hazardous substances must be recognized along with effluents from saline water conversion plants and heated water discharges.
 - IV. Disposition and fate of pollutants in the estuary: dispersion, concentration, degradation, precipitation, disposal to the air
 - V. Field studies of the estuarine environment
 - A. Physical-Chemical factors
 1. Salinity
 2. Temperature
 3. Dissolved Oxygen
 4. Turbidity
 5. Water currents, flushing, tidal action, and other hydraulic features
 6. Wave and wind action

7. Fresh water inflow
8. Phosphates, nitrates, nitrites, silicates, sugar
9. Sediment deposition, removal, character, and variation

B. Biological factors

1. Phytoplankton identification, distribution, abundance, and contribution to the food web
2. Zooplankton; identification, distribution, abundance, role in the food web, and significance as economically important species
3. Fixed vegetation; identification, distribution, abundance, contribution to the food web and habitat value
4. Sessile animals - identification, distribution, abundance, importance in the ecosystem, and economic values
5. Mobile animals - identification, distribution, abundance, importance in the ecosystem, and economic value

VI. Laboratory studies of the physiology and behavior of plants and animals under natural conditions and under pollutional stress.

- A. Responses and tolerance of plants and animals to variations in:
 - a. Salinity

- b. Temperature
 - c. Currents
 - d. Factors of polluttional impact
 - e. Other pertinent physical, chemical, and biological factors
 - f. Combinations of these
 - g. habitat
3. Requirements for optimum production and reproduction of desirable organisms

VII. Legal, economic, and planning aspects

- A. Survey of existing laws and regulations on pollution and environmental conservation
- 1. Adequacy and scope of legislation
 - 2. Enforcement of these laws
 - 3. Identifying needed legislation
- B. Economic studies to determine the values and benefits of the estuary
- 1. Dollar values
 - 2. Recreational and esthetic values
 - 3. Potential values
 - 4. Benefit/cost relationship of exploitation, both existing and potential
- C. Review and development of long- and short-range plans

KANEOHE BAY, HAWAII: A STUDY PRIOR TO INCREASING ITS USE FOR SEWAGE DISPOSAL

This Study was proposed and coordinated by the Water Resources Research Center, University of Hawaii. Cooperating departments of the University include: Agricultural Economics, Public Health, Microbiology, Geography, Oceanography, Geosciences, and the Hawaii Institute of Marine Biology.

The objectives of the study were:

1. To postulate the ecology of Kaneohe Bay prior to its use for sewage disposal
2. To determine the present patterns of water quality and sedimentation in the bay and the effects of present effluents from land on the important elements of the biota, separating, to the extent possible, the effects of sewage effluent discharge and stream discharge
3. To project ecological effects of increased sewage effluent discharges and altered stream discharges as the population of the area increases, assuming present methods of treatment
4. To outline alternative methods of treatment of both stream and sewage effluent and stream discharges, and estimate the effects of their adoption on the ecology of the bay

5. To determine costs of present and alternative methods of control and treatment of both sewage effluent discharge and stream discharge
6. To identify and measure the value of other major uses of the estuary including recreation, industry, bait fishing, and esthetic aspects versus use of the bay as a sink and transporting medium for wastes associated with urban development

The nature of the problems associated with attaining these objectives requires a closely coordinated inter-disciplinary approach. For simplicity in presentation, the procedures followed in this study are described in relation to the several semi-independent programs that are the respective special responsibilities of more or less separately identifiable groups of investigators. It should be recognized, however, that constant interchange of information exists among these groups. The separate studies include:

1. Studies of the plankton of Kaneohe Bay; analyses of the diversity and structure of tropical zooplankton communities.

Included in this work is an attempt to understand the relationships with the open ocean forms and the interdependency that exists. There would also be detailed analyses of trophic relationships and energy flow, as associated with enrichment, transport, and mixing.

2. Studies of the fish and benthos of Kaneohe Bay. Determine the identity, distribution, and abundance of the fish and benthos of the Bay, and relate these to environmental factors
3. Sedimentation of the estuary via the watershed:
 - a. Types of sediment entering the Bay
 - b. Rate of sedimentation, including normal and runoff
 - c. Sediment pattern in the Bay
 - d. Composition and rate of sediment discharge from the Bay to the ocean
 - e. Effects of urbanization and agriculture on erosion and run-off, and on the resulting sediment pattern in the Bay
 - f. Inter-relationships with other studies
4. Bacterial pollution, mineralization processes, and photosynthetic activity
 - a. Extent and magnitude of bacterial pollution from existing sources
 - b. Mineralization processes
 - i. Site of activity: water or sediment
 - ii. Microorganisms involved in oxidizing and reducing processes, including ammonification, sulfate reduction, nitrification, and sulfur oxidation

iii. Chemical and physical parameters

--dissolved oxygen

--pH

--redox potential

--particulate and dissolved organic carbon

--NH₃, NO₂, NO₃, total nitrogen

--total and soluble phosphate

c. Photosynthetic activity

i. Site of activity and light profile of the water column

ii. Productivity rates

iii. Identity, distribution, and abundance of photosynthetic organisms (phytoplankton, attached plants, and bacteria)

5. Water quality factors

a. Tidal ranges

b. Circulation

c. Salinity

d. Temperature

e. Surface runoff and precipitation vs. evaporation

f. Chemical constituents of the water and sediment at selected sites

g. Sewage discharges into the Bay, their strength, volume, and distribution

- h. Effects of sewage discharges on algae, coral, and other biota

6. Engineering analyses

- a. Determine alternative methods for dealing with expected levels of sewage discharge over time to meet a range of specified water quality criteria
- b. Estimate the investment and operational costs of the various alternatives for primary, secondary, and tertiary treatment of the effluent to meet these criteria
- c. Determine methods for controlling stream discharge at various levels of the watershed and project costs for each alternative

- ## 7. Identify and quantify the various uses, present and potential, of Kaneohe Bay and relate the value of these uses to the cost of fostering them.

NEWPORT BAY, CALIFORNIA: REESTABLISHING A DESIRABLE ECOSYSTEM AFTER PHYSICAL MODIFICATION OF THE ESTUARY

Physical modification of an estuary by construction, dredging, filling, and other human activities usually triggers ecological changes followed by a period of readjustment. The natural fauna and flora initially are impoverished but the area is slowly recolonized. Recovery may take years and the final result may not be as desirable or productive as the original community.

Bays and harbors have a specialized biota adapted to estuarine environments. If a species is eliminated by human activities, recolonizing individuals must originate from undisturbed populations in nearby bays. This process usually requires that larval or juvenile forms from the undisturbed population find their way into the ocean, survive there, and thence migrate into the modified bay. It also requires that the modified bay be once again a suitable habitat for the original inhabitants. Probability of such a sequence of events may be low, explaining the long periods generally required for recolonization of a despoiled area.

This particular study would seek to develop methods for facilitating this process. The ultimate climax communities in the modified bay would thus be enhanced both in terms of species diversity and the production of organisms useful to man.

The case study selected here is Newport Bay, California because of the plans being made to develop this area within the next few years.

Bay development typically involves replacing shallow marshland with navigable open water (usually ten to thirty feet deep). Entirely terrestrial islands and peninsulas may be left in the bay or built up by filling. Organic productivity by marsh vegetation is eliminated and the food bases remaining for animal communities are either phytoplankton or dimly illuminated (and hence sparse) bottom vegetation. Populations dwelling in shallow zones find their habitat greatly reduced. Deep-water animals have an expanded habitat, but cannot multiply faster than their basic organic food resources.

If deep water attached plants existed in the Bay, and if they survive the construction activities, they can colonize the newly created deeper bottoms. As plant cover develops, habitats and food resources become available for animal communities. If the proper plants are absent or lost, or if bottom illumination is low, attached vegetation may never gain a foothold. Bay life then depends totally on phytoplankton productivity. Many species, including animals sought by man, cannot utilize planktonic food resources. These forms dwindle or vanish.

Whatever the course of events, results add up to biological impoverishment for years or even indefinitely. Man could intervene in several ways. Most importantly, stands of suitable attached vegetation must be created to provide food bases for animal communities. If desirable fauna and flora totally perish during bay modification, seed stock populations could be introduced to strategic areas. Last, but by no means least, ecological counsel could be provided to planning engineers to ensure that the best possible decisions are made before bay modification commences.

The proposed plan of study consists of several interrelated studies. Objectives can best be achieved by developing information in all these lines of work, more or less concurrently.

1. The important plant and animal species of Southern California bays would be identified and their ecological requirements determined.
2. Various types of construction used in bays (i.e., riprap, bulkheads, pilings, artificial islands, etc.) would be evaluated for suitability as substrata for colonizing organisms. Criteria of suitability are diversity and abundance of species associated with the substrates. Evaluations take account of hydrographic conditions, age of the particular construction, and other modifying factors.

3. To assess feasibility of establishing seed stock populations, transplantation experiments would be conducted with important species and with species possessing excellent potential for enhancing bay environments. Particular attention would be given to seaweeds such as eelgrass (Zostera marina) that frequently dominate significant stretches of bay floor and provide important food bases for animal communities. Animal species that are apt to suffer seriously from construction and dredging during bay modification should also be studied. The transplantations would be particularly valuable if they can follow actual dredging and construction operations.
4. Laboratory cultures of potentially useful seaweeds would be developed. Feasibility of transplanting large numbers of juveniles or reproductive bodies (seeds, spores, etc.) from laboratory cultures to bay environments would be tested. The purpose of this study is to develop techniques for establishing dense stands of attached vegetation over large areas of bay bottom in a relatively short time. If this can be done, the food bases for animal communities in freshly created habitats could be brought into existence rather quickly and should greatly shorten the period for recovery from operations of bay modification. Intensive work would be done on two or three species known to be ecologically desirable such as palm kelp (Eisenia arborea) and eel grass (Zostera marina).

5. Feasibility of conserving portions of populations presently existing in Upper Newport Bay would be studied. As ecological requirements for the various species become catalogued, a basis will be available for predicting survival in various habitats. Many new environments will be created in Upper Newport Bay (for example, shallow underwater slopes of artificial islands). Some of these probably could accommodate organisms presently inhabiting areas that will become unsuitable. The practicality of relocating entire populations will be influenced by several variables (ability of the species to survive transplantation, costs of collecting and then dispersing the population, etc.). Other study phases of this project will provide the information required for making decisions.

SECTION 11. A MANAGEMENT PROGRAM FOR RESEARCH AND STUDY IN THE ESTUARINE ZONE

The conflicts over estuarine use are described and documented earlier in this report. It has been shown that development is proceeding so rapidly that there will be little left to preserve and conserve unless an effective program of comprehensive management is developed and implemented immediately to protect the desirable natural qualities of estuaries. A comprehensive management program can succeed only if it is based on knowledge and understanding of the environment. This knowledge, in turn, can be developed only through a program of research and study in the estuarine zone. The purpose of this Section is to identify the principles on which a technical management program of research and study must be based and to propose the Federal and State roles in implementing such a program.

PRINCIPLES OF TECHNICAL MANAGEMENT

The following ten principles underly a program of technical management. The implementation of these principles constitutes the framework of the proposed program of research and study.

Ecosystems as Management Units

Estuarine resources occur in interacting complexes. What man does to one resource can and does have significant effects on the others. Estuarine and coastal areas exist as ecological

systems, frequently as integral parts of large river basin complexes. The systems concept is thus the most logical approach to sound management of coastal areas. Any plans for the successful development, management, and regulation of estuaries in the United States must be consistent with the ecological and economic principles by which such systems operate, with and without modern man. Because estuarine systems differ from the land systems in having moving fluid, the land laws and practices often do not provide for sensible management and new laws and practices must be developed to recognize the limitations and requirements of estuarine systems. Hence, a management program must involve a total effort toward providing a total solution. More often than not, piecemeal solutions create additional problems, and we find ourselves forced to commit all of our resources to current crises and not able to prepare for the more difficult problems of tomorrow.

Programs for estuarine research and study capable of providing total solutions require not only a multidisciplinary approach but also a sizeable concerted effort, because the areas are both large and complex. Estuarine studies are not wholly the problems of one discipline nor of only a select number of State institutions, but must be carried out by a number of agencies, both private and governmental. A great deal of coordination is needed. The magnitude of the problem is such that use can be made of all interested groups to attain the objectives of optimal estuarine utilization. The single purpose concept of water resources which has been generally abandoned in the development of our upland water resources is still being used in the estuarine area. Such public works as power plants, new ship channels, diked areas, etc., are still

being planned and constructed as individual entities without regard to the entire circulation scheme of the estuary. A great deal of effort must be applied to seek new ideas and even bold ideas for the management of estuaries as total ecosystems.

The Multiple Use Philosophy

As a general guide, the multiple use philosophy must prevail for future planning of estuarine use. Maximum consideration must be given to both public and private enterprise and values in these coastal areas with particular efforts to accommodate all compatible uses practicable. In general, the exploitation of a single resource or a use that is contrary to, or irreversibly precludes other desirable uses, cannot be permitted. The achievement of a desirable balance among uses was a principal purpose of the Congress in commissioning the National Estuarine Pollution Study. However, it needs to be stressed that public recreation areas, wildlife sanctuaries, national defense areas, and other situations of this type are usually single-purpose but frequently desirable.

Evaluating All Potential Uses

Better techniques must be developed for evaluating all potential uses and combinations of uses for a given estuarine area in terms of optimum long-run social as well as economic benefits and including aesthetic and recreational values. Certainly natural science will continue to be an important area of investigation, but the social and humanitarian aspects of the natural environment also will have to be evaluated. This will require definitive economic base studies to define values and uses at all levels, in common terms which will permit option of various use alternatives.

While various uses amenable to benefit/cost analysis should be evaluated in a comparable manner to determine the economic impact of various combinations of such uses, uses not subject to the usual benefit/cost analysis such as fish and wildlife habitat, open space, aesthetics, and natural beauty should, nevertheless, be fully considered as an important aspect of any plan for estuarine development. Criteria with which to judge these sorts of values must be developed and applied equitably along with criteria for the more readily evaluated characteristics. Commercial developments considered essential and which are locationally dependent on estuaries should be planned so as to prevent or mitigate damages to all other public values. The responsible unit of government should require adequate protective measures as a condition of approval of any development plans. As in the establishment of water quality standards, the determination should be justified in terms of overall public or social value rather than solely through conventional benefit/cost analysis. The various techniques and criteria on which these sorts of values will be based will require research of a novel and specialized kind, perhaps abandoning traditional attitudes.

Conserving and Enhancing Estuarine Ecosystems

Estuarine areas must be managed conservatively, leaving adequate margins of safety for protection from miscalculation, political error, or extreme natural variations. At the present time, there

is widespread awareness that we can no longer afford to neglect and destroy estuarine systems which cannot be replaced. The question now is how to accomplish and provide for a sufficient measure of protection for these areas.

Future development of estuarine areas should provide the environmental niches needed by the inhabitants of the estuary and for the use of the estuary as a nursery ground for marine life. Special precautions must be taken not to impair the desirable hydrology of the estuary. Efficient flushing characteristics and innocuous sedimentation patterns must be retained or achieved. This need is consonant with all the other beneficial uses of natural waters except the receipt of waste. Estuarine areas in a state of neglect and poor use should be restored to functional status within the concept of an integrated ecosystem of the whole in-shore region. Methods should be developed for re-establishing the areas of the estuarine zone where desired values have been lost. Special attention must be given to the effect of man upon the water quality of the estuary, for this is the most easily controlled of all the factors in the estuarine economy and yet is one which will most seriously effect the aesthetic, recreational, economic, and habitat value of the estuary during periods of extreme environmental stress. The concept of natural preserves or wilderness areas is well accepted in terrestrial environments. It should be expanded and implemented in the estuarine environment as well, for, if we are ever to

achieve the understanding of estuarine ecosystems essential for their wise management and fullest beneficial use, it is important that we set aside and fully protect a series of representative estuaries along our shores for scientific study and technical management. Such estuarine reserves should be established in several different States, on the east coast, the gulf coast, and the west coast of the United States, as well as in Alaska, Hawaii, and the various island possessions. If this action is not taken soon, we will find that few, if any, estuaries will be left which will be suitable for such studies. It is particularly urgent that use for scientific study be included among the beneficial uses of estuaries.

Coordination of Estuarine Activities

Close coordination and unanimity of purpose among all agencies, institutions, organizations, and individuals having an interest in estuarine areas must be encouraged. This would require cooperation of Federal, State, and local governments, private enterprise, and the public. Communication among the various sciences is often poor, as is communication between the various levels of government and the private sector. Results of work done by State agencies frequently are narrowly distributed. State agencies oftentimes completely overlook or ignore work done by the universities. Federal agencies working on the national level are frequently unaware of the excellent work done at the State and local levels.

It is difficult to over-emphasize the need for the coordination of data gathering, storage, reduction, and retrieval.

An especially important area of cooperation is between all levels of government and the universities, for it is the universities that can concentrate on highly productive research in specific areas on a long-term continuing program. This has the advantage not only of the application of some of the best minds in the country, but also of training the cadre of scientists which will be needed as was discussed earlier. The government agencies should keep the universities aware of its needs and help support appropriate research.

It is also important to recognize that several of the United States' estuarine zones overlap with Mexico and Canada. The Federal and State governments should coordinate their estuarine research and management programs related to these areas with Canada on both the Federal and provincial level and with Mexico on the Federal and State level. The Great Lakes soon will fall into the definition of an estuarine protection area and hence all research and management programs relating to the Great Lakes should be coordinated between Canadian and the United States agencies. Federal funding of State estuarine research projects has and will continue to help coordinate State and Federal efforts. This funding should be expanded to include local, university, and private endeavors in the estuarine zone as well, to increase the scope of coordination.

The Importance of Regional Emphasis

A national program for estuarine study and management should be developed with strong regional emphasis. The United States should be divided into regions corresponding to certain conditions. The biological-physical-chemical properties of estuaries should determine the definition of the regions. Positive estuaries along the Pacific coast from central California northward would comprise one region, the negative estuaries of southern California another region, the highly variable estuaries of the Gulf of Mexico another region, the estuaries of the southeast States another region, and the estuaries of the northeast a fifth region. Chesapeake Bay, south Florida and the islands of the Caribbean, Alaska, and Hawaii, are each unique enough to be separate regions also. These are roughly the biophysical regions which are described and utilized as a basis of information presented earlier in this report. Each region should have a complete inventory of what has been done in the past. Each region should develop a program whereby it would be determined what the estuarine resources of that area are now, what changes may occur to increase these resources, and what changes may be allowed in future development without damaging the current and potential resources of the region.

The Need for Public Planning and Regulation

The public sector must take the initiative by developing plans and enforceable regulations to deal with increasing demands for alteration of land, water, and estuaries, a demand now largely in the hands of the private sector. Strong and competent organizations, such as State or interstate compact authorities, are required to administer these areas, with Federal financial assistance where appropriate, and always on the basis of sound scientific, legal, economic, and social criteria. In most cases, such machinery is not available, nor is the data base on which such machinery must function. Such organizations must be staffed with people competent to analyze and develop quantitative environmental models for evaluating alternatives capable of developing comprehensive plans for carrying out complete regional programs, or must have ready access to such skills through a core of consultants, either Federal, multi-State, or private.

The Need for Estuarine Criteria

A system of criteria must be developed to encourage adequate standards throughout the country covering the allowable extent and conditions of further physical or other alterations of estuarine natural values. Such Federal criteria might well employ the concept used in the development of our water quality standards. In other words, the Federal Government could judge the adequacy of

criteria for the technical management of estuarine areas to qualify for any Federal aid program. Additional Federal funds might be made available to encourage even higher standards or to assure non-degradation policies.

Key Management Roles

The problems of estuarine pollution are essentially of an ecological nature. The resources which we are most anxious to exploit and the nuisances which we wish to prevent are primarily biologically based. The technical management of estuarine systems must be consistent with natural processes; biological, physical, and chemical. Man's activities must be fitted into the natural system -- not forced upon it. All too frequently, the natural environment is mechanically manipulated for narrowly defined economic purposes, and the value of natural areas such as estuaries is threatened or destroyed forever, due to ignoring sound ecological practices. This approach does not deprecate the essentiality of any discipline, for many of the solutions to biological problems can be achieved only through engineering expertise. The very framework within which all estuarine uses occur is the institutional arrangements of the law. It is only the economist who can recognize market and nonmarket values and supply administrators this information so necessary for resource evaluation and allocation.

A part of the implementation of key management roles is training people in estuarine management. The need for answers to the complex problems of the present is great, and will become even more critical in the near future. Research projects such as estuarine pollution studies must provide for supporting new, high-caliber personnel specifically trained for the difficult tasks ahead. Manpower deficiencies exist at all levels of estuarine scientists, engineers, economists, and planners. The lack of funding for training of personnel will be a prime deterrent to getting the more difficult research under way expeditiously. Unless such provisions are included in any management program, complex research programs will move at a frustratingly slow pace, if at all.

The Need for an Informed Public

There must be an informed public willing to support policies and costs leading to the sound technical management of our estuarine and coastal zones. The techniques of informing the public on problems of natural resource management are not as well known as may be assumed by the glib presentations with which we are faced so frequently. Research programs designed toward understanding the public's need and desire to preserve its natural heritage of a beneficial environment are essential. The values, the problems, the achievements of the estuaries must be presented to the public in terms which are meaningful to the electorate. A repetition of

cries of panic and destruction and impending doom serves only to attract the attention of those people who are already interested and concerned. We must achieve better methods of educating the public and preparing them to accept the policies and costs required to maintain a high quality environment for them and their future generations.

Study of these ten principles reveals the most important objectives of a coordinated program of research and study. The fact that the appropriate management unit is the total ecosystem demands that we fully understand the ecology of estuaries and appreciate the need for multidisciplinary studies. Maximum effort must be directed towards implementing the multiple-use concept in the estuarine zone. It follows from this, that all potential uses must be evaluated. Special effort must be made to assess nonmarket values in terms compatible with benefit/cost analysis. Estuarine areas must be conserved and enhanced; damaged areas should be reconstituted; water quality must not be degraded; and habitats should not be destroyed. Natural preserves should be established for study and research.

The various agencies and institutions working in estuaries should coordinate their activities; results of research should be widely disseminated. The national program for estuarine study should be developed with strong regional emphasis based on ecology, geography,

and a commonality of problems and objectives. Planning for estuarine use and development must be based on broad public benefits rather than narrow private interests. A system of criteria by which to gauge estuarine quality is necessary. Key management roles require adequately trained people in ecology, engineering, economics, planning, and law. Finally, the public must be informed of its stake in the estuary.

THE FEDERAL AND STATE PROGRAMS IN ESTUARINE RESEARCH

The primary objective of a program of research and study is to supply the knowledge, understanding, and predictive capability to support a comprehensive national program for the preservation, study, use, and development of the Nation's estuarine zone. To promote the coordination of research activities with management needs, a program of responsibilities and role of the Federal and State government is proposed. These programs are parallel to those suggested in Part III of this Report because of the essential sameness of the goals to be achieved. The difference lies in that the comprehensive program is primarily concerned with the institutional environment, i.e., the framework of law, political institutions, and organizational mechanisms that man must use to provide himself the capability to control, develop, and use the estuarine zone; the research and study program is concerned primarily with the natural environment, i.e., the framework of

knowledge that provides the technical support to achieve the objectives of the comprehensive program.

The Federal Role in Estuarine Research

The Federal Government is responsible for defining the policy and objectives of a national research and study program to support wise comprehensive management of the estuarine zones of the United States. It is also the responsibility of the Federal Government to (a) implement its portion of the announced national program, (b) coordinate the research activities of its appropriate departments and agencies, and (c) augment and encourage the development of new knowledge by State and local agencies as well as by educational institutions. Many of these responsibilities are already receiving attention and the Federal role is one of continuation and augmentation; those responsibilities not yet satisfied require new Federal activities.

The overall Federal role in research should be:

- (1) To provide the impetus for the enhancement, augmentation, and initiation of a national program of research needed to support a comprehensive management system and by offering guidelines for State, interstate, local, and academic actions consistent with developing needed estuarine knowledge.
- (2) To provide continuing support and guidance through grants to State, interstate, and local agencies, and to

academic institutions, foundations, and individuals meeting the research and study needs of the comprehensive management plan. Purposes of such grants should include:

- (a) Research and study of estuarine problems
 - (b) Establishment of estuarine zone laboratories
 - (c) Inventory activities in the States' estuarine zones
 - (d) Training of estuarine scientists
 - (e) Management of programs coordinating research and study activities of separate institutions
 - (f) Enhancement of increased non-destructive estuarine use, such as aquaculture
- (3) Continue broad estuarine studies not of a local nature.
- (4) Participate in local and regional studies where appropriate to augment local and regional research resources.
- (5) Acquire or otherwise develop in cooperation with the States and their political subdivisions selected estuarine areas for preservation and study purposes, as specifically authorized by PL 90-454 and other statutes.
- (6) Supply appropriate support required for the optimum management of flyways, fisheries resources, etc., and

perform studies aimed at improving the utility and values of these areas and stocks.

(7) Coordinate Federal estuarine research activities and provide means for coordinating these activities with those of the States, their subdivisions, interstate agencies, educational institutions, and appropriate foundations and organizations.

(8) In cooperation with the States, continuously monitor developments and conditions and evaluate the effectiveness of the national research and study program.

(9) Maintain a network of Federal laboratories in the estuarine zone to basic and applied research supporting estuarine management. The organization of these laboratories should be based on natural estuarine areas established on the basis of geography, biophysical factors, and commonality of problems. These laboratories would be operated by the Federal Government. Their primary purpose would be to support Federal responsibilities and specific agency missions. There should be a laboratory in each designated estuarine area. They would be staffed along multidisciplinary lines and would attach estuarine problems along the lines of total system analysis and management. The initial nucleus for these laboratories would be established functioning laboratories. Siting future

government laboratories in conjunction with this nucleus would serve the broader needs anticipated in the estuaries.

(10) Support and encourage a network of laboratories specifically performing research, analysis, and development related to the estuarine areas of their region.

These regional laboratories would be under the auspices of institutions of higher education or affiliated organizations competent to study the estuarine zone. They would also serve as scientific and technical advisors to estuarine zone authorities and appropriate State agencies. The research activities should be augmented, as appropriate by participating in consortia and sharing facilities with other public and private institutions. Provision should be made for visiting scholars and for training personnel. The total competence of the regional laboratories should be broad, including scientists, engineers, economists, planners, lawyers and the others necessary for total system analysis and research into estuarine problems and opportunities.

The National Science Foundation should exercise the Federal responsibility for designation and core support of the

regional laboratories, and review and recommend any changes in legislation required to carry out this responsibility.

(11) The Sea Grant College and Program Act of 1966 should be amended to permit grants for construction and maintenance of vessels and other facilities necessary for research and study in the estuarine zone.

The State Role in Estuarine Research

The State role in estuarine research parallels the Federal role in that both governmental entities have the same objectives of estuarine development, use, preservation, and study. Because so much of the needed estuarine research is a cooperative function, much of the previously discussed Federal program also defines the State role. The essential differences lie in the fact that the States are the primary management authority in the estuarine zone and hence possess primary responsibility. As such, they are much closer to the urgency of specific estuarine problems as well as being able to plan more accurately for impending ones. The States' role in estuarine research is thus to implement its portions of the overall national program, to coordinate the research activities of its appropriate agencies, educational institutions, and organizations, and to augment and encourage the development of new knowledge most applicable to its estuaries and their management.

The overall State role in estuarine research should be:

(1) To provide encouragement for the enhancement, augmentation, and initiation of a State program of research needed to support their portion of a comprehensive management program.

(2) To provide continuing support and guidance through:

a. Administering grants to interstate and local agencies and to institutions, organizations, and individuals meeting the research and study needs of the States' comprehensive management plan. Purposes to be served by these grants are:

(1) Research and study of estuarine problems.

(2) Establishment of estuarine zone laboratories

(3) Inventory activities in the States' estuarine zones

(4) Training of estuarine scientists

(5) Coordinating research and study activities of the various agencies and institutions within the State.

b. Cooperative activities between State and other agencies and institutions

c. Technical advice to local agencies and others

d. Promotion of, and guidance and support to, cooperation among the various State agencies doing research in the estuarine zone

(3) Perform broad estuarine studies of a Statewide and local nature.

(4) Participate in studies of interstate estuaries. An example of this is the activities of the Chesapeake Research Council composed of the Chesapeake Biological Laboratory of the University of Maryland, the Virginia Institute of Marine Sciences, and the Chesapeake Bay Institute of the Johns Hopkins University. This brings together a total staff of over 110 scientists to share information and to undertake cooperative research projects.

(5) Acquire or otherwise preserve selected estuarine areas for research and study purposes.

(6) In cooperation with the Federal Government, monitor developments and conditions, and evaluate the effectiveness of the State research and study program.

(7) Participate fully in the activities of the regional laboratories described under the role of the Federal Government.

SECTION 12. STUDY ON COASTAL WASTES MANAGEMENT
NATIONAL ACADEMY OF SCIENCES-NATIONAL ACADEMY OF ENGINEERING

INTRODUCTION

In response to a request from the Federal Water Pollution Control Administration, the National Academy of Sciences and the National Academy of Engineering jointly agreed to provide advice to the Administration on the management of wastes in the coastal marine environment. A study was carried out by a group of experts assembled by the Committee on Oceanography of the National Academy of Sciences (NASCO) and the Committee on Ocean Engineering of the National Academy of Engineering (NAECOE). This group of experts, after a series of planning sessions, met from July 7 through 12, 1969, to examine the following questions:

- (1) What is known about the impact of wastes on the oceans?
- (2) What is known about the magnitude of the impact the marine environment can tolerate?
- (3) What is our present capability to predict future impact of wastes on the coastal ocean environment?
- (4) What investigations should be undertaken in order to improve our ability to respond to the above questions?

Approximately sixty scientists and engineers deliberated on these problems at this session. The results of their deliberations will be in the NAS-NAE report "Wastes Management Concepts for the Coastal Zone - Requirements for Research and Investigation" (in press).

A summary of the recommendations is presented here. It is the purpose of this section of the National Estuarine Pollution Study Report to present the most salient features of the recommendations growing out of that working session.

Early in their deliberations, it became apparent that the four basic questions listed above could best be approached in terms of the following subject areas: a) waste discharge and monitoring, b) physical processes and interactions, c) chemical effects, and d) biological effects. The final NAS-NAE report will be released early in 1970.

GENERAL RECOMMENDATION

One of the greatest contributions that scientists, especially biologists, can make to conserving marine values is through furnishing quantitative guidelines to assist the engineers having responsibility for designing waste treatment and disposal systems. Also, the design of waste treatment and disposal systems must become much more scientifically oriented than in the past. Historically such design has been concerned primarily with maintaining aerobic conditions in the receiving waters and in keeping these waters safe for human health. Now that scientific methods are becoming available for assessing a broad range of marine receiving water values, the engineer's design should become less based on use of "standard" systems and instead be tailored to preserve the specific receiving water values of concern.

RECOMMENDATIONS FOR MONITORING WASTE DISCHARGES AND RECEIVING WATERS

Monitoring Program

Monitoring of the coastal marine environment for waste components and their effects on this environment must be considered on the basis of a total system concept. In this regard, a monitoring system should serve the following functions:

- (1) Provide intermittent or continuous characterization of waste inputs together with the receiving body of water and its terrestrial and atmospheric interfaces. This may

be accomplished by means of pertinent physical, chemical, or biological measurements sufficient to define the significant nature of the water body throughout a time period specified on the basis of statistical validity.

(2) Provide a knowledge of all sources of mass movement into and residence time within the receiving water body, establish the significant character* of such sources, and evaluate the relative contribution of each to the nature of the water body.

(3) Provide for rapid data evaluation and indicate the response procedures appropriate for the given water condition.

Efforts to characterize wastes and receiving waters should take cognizance of the need for rapid, accurate, and economical methods for measurement of the selected parameters. In addition, instrumentation should be adapted or developed to perform the analyses and to transmit or record the observed data. Finally, data analysis techniques should be developed so that corrective action can be initiated promptly.

* The phrase "significant character" for these purposes is in need of further definition and this subject is dealt with in the main part of this report. Criteria for such classification would necessarily have to be applied on a case-by-case basis.

In any monitoring program the value of observed data depends upon:

- (1) Sampling procedures which provide samples representative of the condition of the air, land, and water interfaces at any point in time.
- (2) Sufficient vertical and horizontal control points, the samples from which will adequately describe the system.
- (3) Sufficient frequency of sample collection to validate the analyses within any pre-selected statistical confidence limits.
- (4) Analytical procedures which are of defined precision in terms of the parameter being measured.

In recognition of the fact that the character of one restricted water body or coastal regime is quite likely different from another, no recommendation can be made concerning the items 2, 3, and 4 above without enumerating the definitive characteristics of each water body. This hopefully will be accomplished by a monitoring program with sufficient sampling locations and with sufficient frequency to describe the system within reasonable confidence limits.

It is realized that any monitoring program designed to meet what are present, and as well as can be predicted, future needs may require modification from time to time. It is, therefore, obvious that periodic examination must be given to monitoring specifications to insure their continuing adequacy and to remove redundancy.

Monitoring Waste Discharges

It was concluded that specifications should be developed for a minimum or core type monitoring program that should be applied to all "significant" waste discharges. "Significant" waste discharges are not defined herein; but they are to be defined as part of the recommended research and development program. However, they are considered here to include but not necessarily be limited to the following candidate waste materials:

- (1) Municipal and industrial waste streams;
- (2) Storm runoff and combined sewer overflows;
- (3) Water courses containing significant waste materials;
and
- (4) Batch waste dumping and barging operations.

It should be recognized at the outset that it is both logical and likely that all waste discharges, especially minor ones such as the treated strictly domestic wastes from 100 persons discharging into open coastal waters, would not be classified as "significant." On the other hand, it should be recognized that many major waste discharges will require many more analyses than the core minimum program to characterize properly the waste discharge characteristics.

- (1) Objectives: The general objective of the core waste discharge monitoring program is to provide the minimum information needed to assess adequately the pollutional

contribution of waste materials to the Nation's coastal environment. Specific objectives would include but not necessarily be limited to the following:

(a) To provide quantitative information on the unit and total mass emission rates for the common significant groups of pollutants from significant waste-generating activity such as municipal, industrial, agricultural, natural, and other sources so that:

[1] Adequate data are available for forecasting future waste contributions based upon the level of future estimated waste-generating activity (population, industrial production, etc.);

[2] Accurate input data are available for use in various modeling systems to provide estimates of waste concentrations and their variation in space and time; and

[3] It is possible to attempt to correlate or develop functional relationships between waste emission rates and waste effects which are principally biological in character.

(b) To assess performance on a gross basis of waste treatment installations.

(c) To insure that adequate information is available to permit improvements in waste treatment and disposal system design and operation.

- (d) Other specific needs are met on a particular problem basis.

The general characteristics of the minimum monitoring program are described below:

- (2) Sampling: All samples (except for grab samples collected for special analyses for high decay rate constituents) collected for routine analysis should be near-continuous, proportional composite samples which accurately represent the characteristics of the waste stream (i.e., floatable, suspended, and dissolved constituents) with respect to their true mass emission rates (i.e., lbs/day).

Sufficient samples should be collected to provide an adequate statistical description for both the constituent concentration and the mass emission rate of the contaminant. After the waste has been statistically defined, analyses not pertinent to the local problem or to the wastes characterization should be deleted.

- (3) Analyses: The following analyses should be conducted on essentially all samples collected:

- (a) Floatable matter - Method needs development
- (b) Total and Organic - Methods Adequate
Suspended Solid
- (c) Acute Toxicity - Method needs review

- (d) Persistent Pesticides - Method needs review
- (e) Persistent Organic Compounds - Method needs development
- (f) Biostimulants - Method needs development
- (g) Gross heavy metals - Method needs development
- (h) Coliforms (or equivalent) - Method under continuous review
- (i) Radioactivity - Methods adequate

(4) Supplemental information:

(a) Information on the accuracy and precision of both the sampling and analytical methods is to be obtained and reported.

(b) Data should be obtained on the level of waste-generating activity (i.e., for municipal waste - population tributary; for industrial wastes, level of production and type - tons of product/day, etc.) so that waste discharges can be reported on a unit mass emission rate basis (i.e., lbs SS/capita-day or lbs SS/10³ lbs product)

(5) Significant discharge: It should be noted that the recommended minimum monitoring program is, as stated, the minimum to be applied to all "significant" waste discharges. Many significant waste discharges may require numerous additional characteristics or parameters to be added to the minimum listing to describe properly the waste

characteristics. For example, cooling water discharges may require numerous additional characteristics or parameters such as temperature, heat flux, density, etc., to be added to the minimum listing to describe properly the waste characteristics.

Considerable investigation and study will be needed to define properly waste discharges that should be specifically included in the "significant discharge" category. It should be obvious that a number of considerations are involved in the decision as to whether or not a particular waste discharge is "significant." Some of the considerations are:

(a) The magnitude (flow and pollutant mass emission rates of the discharge as compared to:

[1] The available dilution and quality requirements of the receiving waters;

[2] The relative magnitude of the discharge as compared to other discharges in the general area; and

[3] The defined or undefined character of the effect of the waste on the receiving water and beneficial uses.

(b) The relative cost of conducting the minimum "core" characterization program as compared to:

[1] The cost of at least secondary treatment for the waste discharge;

[2] The cost of alternative and possible inferior methods of disposal; and

[3] The potential damage of the discharge.

Specifications for the "significant discharge" category must be sufficiently general so as not to exclude some specific and significant discharges of potential ecological damage.

Monitoring Receiving Water

To make a basic assessment of the condition of receiving waters and the effect thereon of the discharge of treated effluents, the following tests are recommended for a minimum core monitoring program for the water column and sediments (Table VI.3.1). It should be noted that the core monitoring program is not intended to be applied in its entirety to all marine waters but only to those bodies of water that receive "significant waste discharges."

Table VI.3.2 presents a summary listing of the recommended core program analyses of the waters and sediments and indicates their recommended application to either restricted waters or the open ocean, or both.

Table VI.3.1

Recommended Tests

Water Column	1. Physical	a. Quantification of floatable material and films with analysis for determination of probable origin of material (require method development) b. Water clarity by photometric or other methods (methods adequate) c. Temperature - continuous recording with depth or at least three points in vertical column (method adequate)
	2. Biological	a. Coliform determination (method needs evaluation) b. Biostimulatory characteristics (method to be developed) c. Assessment of biomass including standing stock and community structure to determine long-term effects of waste discharges (techniques to be developed)
	3. Chemical	a. Dissolved oxygen (method adequate) b. Chlorosity (method adequate) c. pH (method adequate) d. Nitrates (method needs periodic evaluation) e. Phosphates (method needs periodic evaluation)
	1. Physical	a. Particle size distribution (methods adequate) b. Temperature (methods adequate)

Table VI.3.1
Recommended Tests - Continued

Sediments (cont'd)	1. Physical (cont'd)	c. Other observations may also be needed for particle density, in-place density, and thickness of waste deposits to permit an estimate of the volume and mass of wastes accumulated (techniques need evaluation)
	2. Biological	a. Quantitative description of the standing crop of benthic organisms (quantitative technique needs development) b. Other tests including an index of bottom respiration may be useful to indicate the amount of readily biodegradable organic matter in the deposit (technique needs development)
	3. Chemical	a. Concentration of organic matter by concentration of organic carbon or organic nitrogen (technique needs evaluation) b. Presence or absence of H ₂ S (quantitative technique needs evaluation) c. pH (technique adequate) d. Other measurements should be made for suspected toxicants when appropriate including specific trace metals (technique needs evaluation)

Table VI.3.2

Summary of Recommended Core Program Analyses
Water Column and Sediments

Analyses	Restricted Water	Ocean Water
<u>Water Column</u>		
<u>Physical</u>		
a. Floatables and Films	X	X
b. Clarity	X	X
c. Temperature	X	X
<u>Biological</u>		
a. Coliforms	X	X
b. Biostimulants	X	X
c. Biomass Characterization*	X	X
<u>Chemical</u>		
a. Dissolved Oxygen	X	
b. Chlorosity	X	X
c. pH	X	X
d. Nitrates	X	
e. Phosphates	X	
<u>Sediments</u>		
<u>Physical</u>		
a. Particle Size Distribution	X	X
b. Temperature	X	X
<u>Biological</u>		
a. Benthos Characterization*	X	X
<u>Chemical</u>		
a. Organic Matter	X	X
b. H ₂ S (Presence or Absence)	X	X
c. pH	X	X

*Quantitative

RECOMMENDATIONS CONCERNING PHYSICAL PROCESSES AND INTERACTIONS

Initial Dilution and Diffuser Design

(1) Present knowledge of buoyant jet diffusion is nearly adequate for design of an outfall (including a multiple-port diffuser) to achieve a prescribed initial jet dilution and submergence below any given thermocline. However, further research is needed in a number of areas. Primarily, there is need for understanding of line sources, and how well multiple-jet diffusers may be represented by line sources. Although current effects on initial plume behavior are not well understood, they are not as critical as density stratification as a factor in predicting initial dilutions due to jet mixing.

(2) Methods do not exist for predicting the size and shape of waste fields (of either conventional or heated effluents) which are developed at the end of the initial jet-mixing stage. Closely coupled with this is the problem of lateral spreading due to density differences between the field and its environment. Research should be conducted on both of these problems.

(3) For barge dumping of sludges in the ocean, research is needed on flows generated by suddenly released sinking sludge in a stratified environment.

(4) Control of thermal pollution in coastal waters involves the same kind of stratified flow problems as sewage disposal. Inasmuch as large submerged diffusion structures are not in use yet, some problems of large single jets need special study, such as the behavior of a buoyant surface jet injected in a stream perpendicular to the current.

(5) Field studies of flow patterns and dilutions over waste outfalls are needed urgently to confirm design predictions and methods. Most of the hydrodynamics of buoyant jet mixing has been confirmed only in laboratory experiments.

Physical Processes in Estuaries

It is necessary to develop a sound physical basis for quantitative predictive models of time and space variations of constituent distributions in estuaries. This will require further work on theoretical, numerical, and physical models, determining the correlation between the models and field studies. Priorities need to be set based on the urgency of the practical problem and the relative degree of understanding of the particular class of estuary. The most urgent problems are likely to occur in those estuaries which we know the most about, primarily coastal plain estuaries.

(1) Further knowledge is required of the relationship of the mean circulation, tidal currents, and turbulent exchanges to the river inputs, external tides, external density distribution, wind, and the shape and size of the estuary.

(2) There is little knowledge of conditions responsible for the change in an estuary from a salt-wedge to a partially mixed estuary, or from a fjord to either a salt-wedge or partially mixed estuary. These conditions need study, particularly those in fjords.

(3) In the development of models, both theoretical and numerical models should be stressed as they include the possibility of the incorporation of biological, chemical, and physical processes at prototype scales.

(4) The turbulent processes need investigation as their dependence on density stratification and mean velocity shear plays a dominant role in the behavior of these estuaries.

Turbulent Flux and Diffusion

(1) Detailed observational approaches to the problem of turbulent diffusion are needed. Simultaneous measurements of turbulent fluctuations in velocity, salinity, and other properties together with environmental factors such as shears in mean velocity and stability of the water column are necessary. Likewise, tracer studies on a scale of 10-100 meters should be carried out under various environmental conditions.

(2) There is need to develop predictive models for gross spreading of patches and plumes in the ocean from the combined effects of eddy diffusion (both horizontal and vertical) and shear in the mean velocity field. The research in item 1 above will provide a basis for this development and will allow a better interpretation of previously reported values of gross dispersion coefficients.

(3) It is recommended that systematic tracer experiments be carried out in subsurface waters in order to have more reliable information on the dispersion or rate of speed of a patch or plume. These experiments should include the use of artificial tracers, such as fluorescent dye, and studies of existing waste fields which occur at subsurface depths.

Physical Processes in Coastal Areas

(1) To achieve a proper understanding of coastal circulation on all scales, a program of collection of oceanographic and meteorological data is recommended. The observations should be made over a long enough period of time to reveal all periodicities up to and including annual. Although such a program could be carried out by multi-ship operations, moored arrays of instruments capable of sampling the entire water column would probably be better. Such a program should

permit evaluation of wind, river inflow, tide, and internal waves as transport mechanisms.

(2) To improve our ability to predict the fate of pollutants introduced into estuaries and coastal waters under specific environmental conditions, a study is recommended of the effects of intermediate scale variations in the current pattern on the time varying concentrations of waste components at various distances from the source, using tracers such as fluorescent dyes as well as waste components from existing outfalls.

(3) It is recommended that the large-scale processes which lead to exchange of coastal water with oceanic water be studied. One possibility is the development of a fluorometer capable of sampling at all depths which is an order of magnitude more sensitive than at present so that large-scale dye tracer experiments could be carried out economically. Another possibility is a search for a more economical tracer.

Decay of Non-Conservative Constituents as Related to Physical Factors

A series of controlled field experiments should be conducted to study the non-conservative properties of such constituents of wastewater as enteric bacteria and other toxic substances discharged into coastal and estuarine waters. As soon as reliable detection and enumeration

techniques have been developed these studies should be expanded to include pathogenic viruses.

Interactions Between Floatable and Settleable Components of Wastes and Physical Factors

Floatables are defined here as those materials which appear at the air-water interface. These materials may appear in the form of floating particulate matter (detritus), surface films (monolayers, duplex, or lenses), scum, and foam.

(1) Studies should be conducted to ascertain the prevalence, properties and character of floatables of wastewater and sludge origin (including barged materials) in coastal waters and in estuaries. The substances comprising the various forms of the floatables (particulate matter, films, scum, and foam) should be identified as to primary source.

(2) Investigations should be made to determine the means by which the floatables are collected and compressed into slicks or streaks on the water surface as well as the natural mechanisms available for transporting the materials in the water surface.

(3) Studies should be made to ascertain methods of treating or handling the wastewaters and sludges to reduce or eliminate problems of surface pollution.

(4) Studies should be conducted to evaluate the movement and dispersion of releases of sludge at sites currently in use, such as in the New York Bight and off southern California. These studies should include, but not necessarily be limited to, investigation of the methods of introducing the sludge, i.e., by barge or outfall, and the transport mechanisms, including settling and resuspension, which influence the distribution and spread of the materials.

RECOMMENDATIONS CONCERNING CHEMICAL FACTORS

Research Preserves

Because of the enormous complexity of the physical, chemical, and biological interactions in marine ecosystems, there should be a system of ecological classification of natural coastal systems that can be used to make first approximations of the impact of specific types of wastes on them. Such classifications may require new geochemical surveys of coastal systems, but in large part could be erected from extant knowledge.

The classification of coastal systems should be used to select and set aside type preserves for experimental use, for such purposes as stressing the environment to determine the effects of the stress and the rate of recovery of the system when the stress is removed. Such study areas would allow the carrying out of experiments that might not be permissible in areas not so set aside, and would prevent the intrusion of other human influences. The stresses applied might include the addition of growth-suppressing substances, nutrient substances, heat, etc. The study areas would be provided with adequate laboratory facilities for intensive investigation and manipulation.

Type systems to be set aside should include tropical, temperate, and boreal systems, and would include open coastal areas, salt marsh estuaries, tidal estuaries, salt-wedge estuaries, mangrove swamps, and fjords. They should encompass systems of varying depths, sizes, and

geomorphology to permit the collection of data to construct models useful for coastal waste management. We consider this to be a matter requiring immediate attention.

Chemical Processes Involving Dissolved Inorganic Constituents

(1) The concentrations and the forms of trace elements believed to be biologically significant in the waters and sediments and their concentrations in organisms in different areas should be determined. The forms in which these elements occur affect their availability to organisms. Areas that should be examined are near the mouths of large rivers and coastal areas where fresh water inputs come primarily from waste water discharges. The elements of concern would probably include but not be limited to copper, zinc, cobalt, chromium, arsenic, molybdenum, selenium, mercury, cadmium, and lead.

(2) The degree of complexing of trace metals by the organic and inorganic constituents of wastewater effluents, sea water, and estuarine waters should be evaluated in both laboratory and field studies. Temperature ranges in the natural environment as well as in the vicinity of thermal outfalls should be represented in the experimental program. Not only may the degree of complexing prove significant in controlling the behavior of the metal ions,

it may be pertinent in understanding the action of organic residues. The forms in which the metals exist are important factors in their biological activity.

Chemistry of Particles and Processes in Sediments

(1) Experiments should be carried out to establish the effects on soluble components, particularly waste solutes, of flocculation, aggregation, coprecipitation, and sorption. A study should be made of the physical-chemical factors and the role of organisms in affecting the flocculation rates of sediments in estuaries and coastal waters. Pertinent variables appear to be in the degree of dilution of fresh water suspensions entering sea water, the levels of organic matter, the pH of the mixture, the oxidation potential, the relative percentages of different clay minerals and other solid phases, the mixing characteristics of the flow, and the temperature.

(2) The rates of aggregation and sedimentation of organic particles in the marine environment should be studied. Such factors as pH, temperature, organic-metal ion complexing at organic particle surfaces, and the concentration of inorganic particles should be evaluated. Organic debris appears to play a role in transporting trace metals to the sediments. The organic debris may associate with inorganic

particles, thus affecting the sedimentation of inorganic phases (oxides, clays, silica).

(3) The biological and chemical transformations occurring in polluted and unpolluted sediments should be determined with particular reference to nutrients and trace elements. These studies should include considerations of concentration gradients, movement of water at the sediment interface, eddy diffusion, and the release of gas on the rates of transport from sediments to the water column. Also included should be the effects of changes from oxidizing to reducing conditions and vice versa.

(4) Adequate procedures must be developed for distinguishing among inorganic particles, living organisms, and dead organic matter, both in the water column and in the sediments.

Nutrient Chemistry and Biochemical Changes

(1) The fluxes of nitrogen and phosphorus in all phases of the cycles affecting the marine environment should be explored. The study should not overlook the fluxes due to rooted benthic plants, birds, and humans.

(2) An understanding should be developed of the amount and character of dissolved and particulate organic matter in the ocean, its origin, including the contributions from

rivers and waste discharges, its spatial distribution, and its biological significance.

(3) A study of the factors that control the qualitative and quantitative aspects of phytoplankton blooms in estuarial and coastal waters should be carried out.

(4) The effects of additions of nutrients (phosphate, nitrate, silicate) and oxidizable carbon on the primary productivity and on the resulting organic load in restricted coastal environments should be determined. The relative effects of the individual nutrients are important considerations. The rates of oxygen exchange between the atmosphere and other sources (e.g., ferric oxide in sediments) and the coastal waters should also be studied. These studies will help predict to what extent re-aeration can compensate for the oxygen demand caused by the introduction of oxidizable carbon and nutrients from waste outfalls. Factors such as wind stress, depth, pressure head, density gradient and stability, and surface films such as petroleum should be considered.

(5) The biochemical mechanisms for concentration of trace components by the biota, the subsequent effect of this concentration on the organisms involved, and the transport and and further concentrating of these trace components as they move up the food chain should be determined.

(6) Subtle, non-lethal effects of waste products on physiological and biochemical processes, such as enzyme induction or inhibition, ion transfer across membranes, and chemosensitive reception should be studied. Such effects may significantly influence the growth, reproduction, development, or survival of marine animals in ways not detected by conventional assay or toxicity tests or population studies. It is in this area of sub-lethal effects that ocean disposal of wastes may encounter its most serious problems.

The Chemistry of Specific Pollutants

(1) In view of increasing pollution by oil leakage and bilge washings from ships, by catastrophic events such as shipwrecks, and by oil seepage and operating wells on the continental shelf, research is needed on:

- (a) natural biochemical processes responsible for degradation of oil films or oil droplets;
- (b) techniques of analysis for detecting and characterizing low concentrations of oil in water and for identifying sources;
- (c) the effects of different oil dispersants in degradation of the oil, the toxicity of dispersant and dispersant-oil mixtures to marine organisms, and the uptake of the oil, dispersant and/or dispersant-oil mixtures in the food chain;

- (d) the effects of added settling agents on bottom characteristics and on benthos, and the fate of oil so deposited;
 - (e) fractionation of oil films on exposure to environmental influences, and the fate of residual materials in the sea; and
 - (f) the effect of oil films on the air-sea oxygen exchange; and interference in processes of biological productivity, such as changes in light penetration and mixing.
- (2) The fluxes of synthetic organic chemicals into the ocean through sewage outfalls, rivers, atmosphere and biota should be determined. Priorities should be given to potentially hazardous or deleterious materials such as pesticides, detergents, fuel residues, certain solvents, etc.

Chemical Consequences of Man's Physical Activities

- (1) The effects of human activities (such as forestry, agriculture, terrestrial and marine mining, dredging, impoundments, etc.) on the flow of inorganic suspended matter to the oceans and on the distribution and character of the sediments should be determined. Among the potentially significant effects are those on transparency of overlying waters, oxygen demand from reducing sediments, transport

or release of nutrients including trace elements, alterations of the benthos, silting of harbors, and erosion of beaches.

RECOMMENDATIONS CONCERNING BIOLOGICAL EFFECTS

Current waste disposal practices have often resulted in obvious deterioration of certain estuarine and coastal marine environments. Adequate techniques are not at hand for definitive assessment of all of the important impacts of wastes (including domestic and industrial effluents) imposed on coastal waters. Nevertheless, there is a strong sense of urgency to adduce now whatever useful information can be obtained with existing methods. Four areas urgently need increased attention.

(1) Studies should be made immediately of existing outfalls and disposal areas of a variety of magnitudes in several distinct marine biogeographic provinces. These studies and relationships derived from them must serve as an interim basis for improved evaluation of the acceptability of new disposal facilities and sites. They must include at least the following:

- (a) Quantitative floral and faunal surveys in the immediate vicinity of discharge, within the measurable zones of influence and at reference sites.
- (b) Sludge fields (when present).

- [1] Measurement of the temporal and spatial dimensions of sludge fields
 - [2] Chemical analyses of sample sludges from various outfalls with emphasis on substances likely to have biological importance, and
 - [3] Measurement of the rates of biodegradation and utilization of sludge components by marine organisms,
- (c) Determination of the dissolved inorganic and organic substances resulting from coastal discharges and their effects by means of
- [1] A chemical inventory of components,
 - [2] Bioassays of both effluents and affected waters for toxicity and stimulation, and
 - [3] A study of primary productivity and other community responses in affected waters.
- (2) A detailed examination of the public health significance of coastal discharges should be made, including;
- (a) Re-evaluation of the adequacy of traditional fresh water biological indices in marine waters and in organisms consumed by man, and
 - (b) Development and application of improved indices.
- (3) Research on the biological concentration of waste components by marine organisms should be expanded and intensified. Special attention must be given to organisms

involved either directly or indirectly in the food chain of man, without sacrificing adequate attention to the complete environment.

(4) The input of DDT into the marine environment by the United States should be eliminated. In order to avoid a repetition of the DDT type of problem, we further recommend that any material that combines the properties of mobility, chemical stability, low solubility in water and high solubility in lipids be kept out of the marine environment unless it has been proven not to have the broad biological activity that is characteristic of DDT.

(5) The U.S. Government should provide encouragement and funding for increased graduate education in the combined fields of oceanography, ecology, and engineering in order to provide the manpower and competence necessary for ensuring rational use of the nearshore ocean and estuaries. In order to make this effective, certain other fields, especially taxonomy and marine chemistry, must also be encouraged and funded.

(6) The U.S. Government should take the initiative, in cooperation with the States, in development on a broad regional basis of a long-range plan for the uses of the coastal waters and estuaries that would be affected by wastes. The plan should project uses for at least 10 years from the current year and be subject to periodic review

and adjustment. The area considered should extend as far from the coast as wastes are likely to have significant effects. The plan should include designation of uses and the setting of standards of tolerable pollution consistent with the uses. This planning must take into account the total water resources of each region.

(7) Long-range, properly designed, detailed, quantitative studies of the structure and dynamics of animal and plant communities and their relationship to waste disposal in carefully selected areas should be established and supported. These areas should include those that are relatively little affected, those being affected at an increasing rate and those that are already seriously affected. Some of the studies should be done in designated and protected marine preserves. All should be related to the uses defined in the long-range plan.

(8) Programs of physiological studies to define the tolerable limits of pollution for each of the specific uses envisioned for the zones designated in the long-range plan should be established and supported.

(9) Programs of systems analysis and model development that will improve prediction of the biological effects of various possible combinations of waste treatments, disposal systems and uses of the receiving water should be instituted and supported. As more data become

available from the studies suggested above, models can be continually refined.

(10) All proposals for new installations, modifications or activities that may result in major changes in the amounts or nature of the pollutants should be reviewed to determine whether quantitative ecological studies of the biota are required, both before and after the change. If such studies would lead to greater protection of the biota or provide better bases for regulation, adequate funds for them must be included in the budget. Enough time must be allowed for careful studies, especially those to be done before the change is made. The data from such studies would increase the accuracy of models and would strengthen the objective bases for setting standards.

(11) The U.S. Government should encourage the coordination of wastes management over large regions in order to obtain more economical and efficient treatment. This will allow better use of the limited supply of high quality manpower, improve management of waste disposal and allow better control. It will lead to better regulated, and probably reduced, effects on the biota of the receiving waters.

(12) All of the preceding programs must be subjected to frequent, independent assessment by outside experts in the fields concerned.

(13) Because the biological impact of many pollutants is international, the U.S. Government should accelerate negotiations looking toward international control of pollution of international waters by both airborne and waterborne toxicants.

(14) The U.S. Government should consider and act effectively upon the ultimate disposal problems and the biological effects of new products of any kind which, after release in the commercial market, could result in the impairment of the biological values of the marine environment. The burden of proof of biological effects must rest with the manufacturer.

SECTION 13. SUMMARY AND CONCLUSIONS

The purpose of this Chapter is to identify the estuarine problems and areas requiring further research and study. The discussion represents a synthesized consensus of the leading estuarine scientists, engineers, planners, and economists in various universities, organizations and Federal, State, and local government agencies; fifteen professional organizations in the forefront of estuarine research; the public, as determined in thirty public meetings; several special studies; the Office of Research and Development of the Federal Water Pollution Control Administration; and the combined Committee on Oceanography of the National Academy of Sciences and the Committee on Ocean Engineering of the National Academy of Engineering.

A great deal of technical and socioeconomic knowledge is necessary to support a comprehensive program of estuarine management. This knowledge must be supplied through multidisciplinary efforts. The knowledge thus developed must include: (1) knowledge and understanding of the biological, physical, and chemical factors of the estuarine zone, (2) knowledge of the institutional framework governing each portion of the estuarine zone, (3) knowledge of the demographic, social, and economic factors and their trends, (4) establishment of goals and uses so that future studies can be relevantly oriented, and (5) an augmentation and synthesis of the previous four adequate to enhance estuarine management.

The most important knowledge to be gained is an understanding of the estuarine environment adequate to permit the recognition and interpretation of causal relationships which, in turn, provides the capability to predict the effects of natural and human activities in the estuarine zone and hence supports a program of technical management. The research programs which will yield this information are in the categories of:

- (1) Ecology, taken to include baseline information, broad ecological studies, biology, water quality, natural variability, and interface factors.
- (2) Toxicity, taken to include bioassay needs and methodology, sublethal effects, and mortality phenomena.
- (3) Microbiology, taken to include the regeneration of plant nutrients, biodegradation of organic wastes, eutrophication, and pathogens.
- (4) Physics and mathematics, taken to include hydraulics, sedimentation, effects of structures and physical modifications, and physical and mathematical modeling.
- (5) Socioeconomic factors, taken to include planning, economics, law, social and demographic factors and trends, resource evaluation and allocation, and the role of technical research and study in supporting a comprehensive management program.
- (6) Ancillary research and study needs, taken to include environmental monitoring, methodology (both laboratory and

field techniques), data processing, training needs, and estuarine zone laboratories.

Chapter 4

SUMMARY

Two major efforts in the National Estuarine Pollution Study have been directed toward two interlocking goals. One has been the development of the National Estuarine Inventory, which stores the masses of information gathered to satisfy the directive, ". . . . The Secretary shall assemble, coordinate, and organize all existing pertinent information". This data assembly has also led to definition of large data gaps.

The second effort has been to investigate by various methods the state-of-the-art in estuarine sciences in order to " identify the problems and areas where further research and study are required".

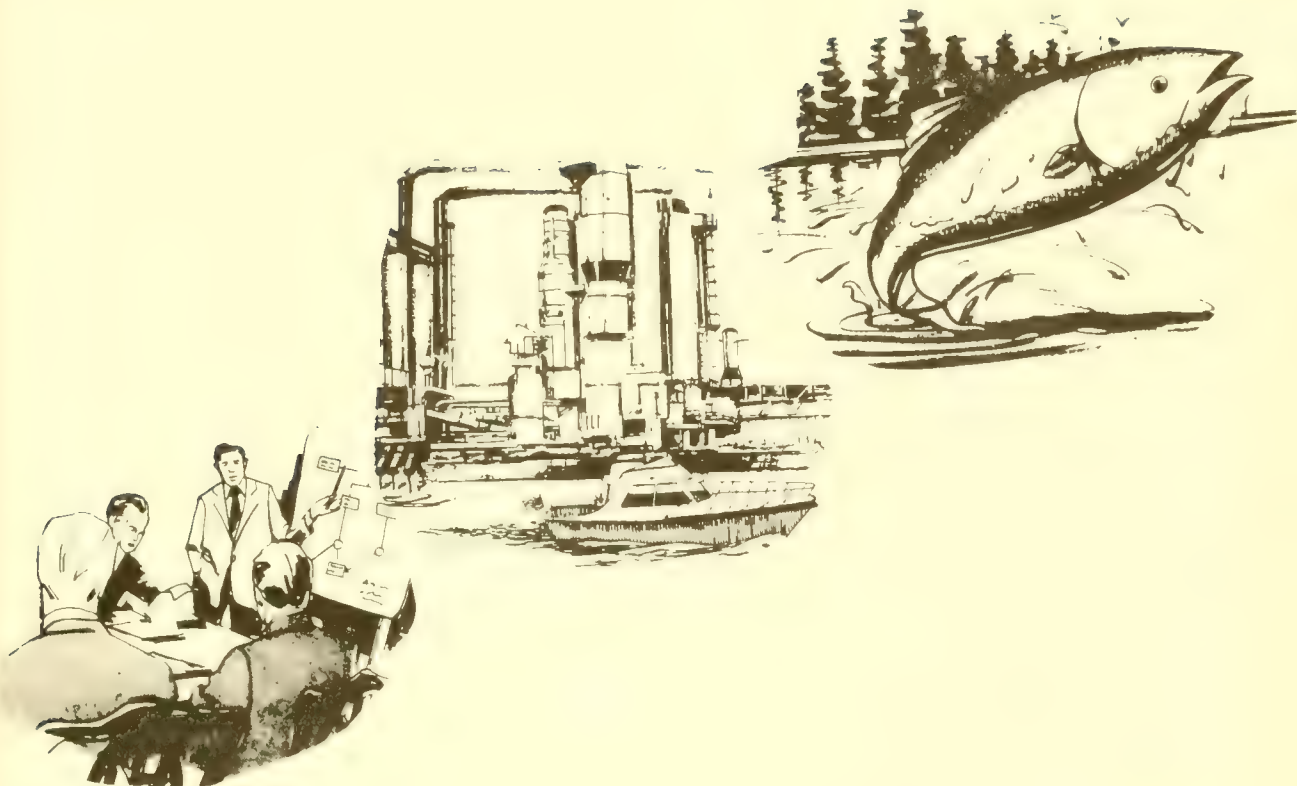
The programs submitted in Chapters 2 and 3 of this Part appear in several instances to overlap. In those cases the intention is not to develop two different programs, but to develop a single program to serve two different needs. The difference lies in the rather subtle implications of the two terms "basic data" and "basic knowledge". These are symbiotic terms, for without the one, the other does not exist.

The National Estuarine Inventory itself has proven to be a valuable tool in several respects. Although its prime function is to provide information for estuarine management, it can also serve several

other purposes including the following:

- 1) A central storehouse of basic estuarine information;
- 2) A delineator of data information needs;
- 3) A link between existing Federal data systems;
- 4) A mechanism for evaluation of estuarine-related programs (such as sampling networks); and
- 5) A device to provide data for estuarine systems analysis studies.

In the final analysis, the Inventory and the programs outlined in this Part are designed and submitted as integral parts of a national program of rational management, preservation and use of the nation's estuaries and estuarine zones.



Part VII

COLLECTION OF SUPPORTING INFORMATION

INTRODUCTION

The preceding parts of this report represent in relatively brief form the efforts of the National Estuarine Pollution Study, acting on behalf of the Secretary of the Interior, to "assemble, coordinate, and organize all existing [available] pertinent information on the Nation's estuaries and estuarine zones . . . " as dictated by Sec. 5g of the Clean Water Restoration Act of 1966.

The source information was obtained from many different sources, constitutes a tremendously large mass of materials, and includes published and unpublished material in the technical and scientific literature. The quantitative data in the sources was abstracted and consolidated in the form of the National Estuarine Inventory, described in Part VI.

In general the sources can be grouped into four categories -- transcripts of estuarine study public meetings, Federal and State profiles, estuarine study contractors' report, and the reference collection. The sources are described, herein, only in general terms because of the already voluminous nature of this report. The preceding parts contain references only to those documents which constitute an intergral part of the text. A list of all the documents would unduly burden the report and the reader.

TRANSCRIPTS OF PUBLIC MEETINGS

During 1968 and 1969, the National Estuarine Pollution Study

conducted 30 public meetings across the Nation to provide a forum of contacting and receiving the views from the public and private sectors and also from individuals not already contacted and wishing to present their views on the current situation in the estuarine zone. The actual proceedings of these meetings were recorded and most of the transcripts have already been assembled into individual volumes for use in preparing this report and also for future reference. The assembly has been handled by the Study's regional representatives. Since the transcripts represent the actual statements by the attendees, selective distribution has been made to those people involved or interested in the conduct of the Study. A limited number of additional copies are being retained for future reference. Volumewise the transcripts amount to several thousand pages of copy. These transcripts are referred to as Transcripts of the Estuarine Study Public Meetings in the place where they were held. A list of the meeting sites, dates of occurrence, and analysis of them are included in Chapter 5 of Part V. A few of the transcripts has been summarized in the form of brief brochures covering the highlights of the particular meetings. A limited number of these brochures are retained for reference.

AGENCY PROFILES

Information on the estuarine-related programs and responsibilities received from the Federal agencies participating in the Study, and from the coastal State governments have been summarized in the form

of profiles which were used in the preparation of the chapters in Part V dealing with the roles of the Federal and State agencies. These profiles have been retained in manuscript copy for reference but not for distribution.

CONTRACT REPORTS

During the course of the Study, some 22 contracts, including reimbursable agreements, were awarded to other Federal agencies, academic institutions, investigatory organizations, and individuals to develop documents surveying a particular phase of the total scope of the Study. All of the contracts were designed to result in reports, retained in manuscript copy, for analysis and use in preparing the chapters, primarily in Part IV, of the report. These documents, because they are in manuscript copy and represent selected, isolated phases of the total scope of the Study, have not been released or prepared for distribution by the Study. However, press releases and information sheets on these contracts have been prepared and distributed. The project titles and name of contractor are as follows;

- (1) University of North Carolina -- State-of-Knowledge on Estuarine Ecology and the Effects of Pollution on Estuarine Ecosystems.
- (2) University of Washington -- Socio-Economic, Institutional and Legal Considerations in the Management of Puget Sound Estuarine Resources.

- (3) University of Maryland -- Analysis of Legal Problems Related to the Development and Management of Chesapeake Bay Resources.
- (4) Florida State University -- An Analysis of the Socio-Economic Values of Apalachicola Bay, Florida.
- (5) University of Rhode Island -- Socio-Economic Study of the Narragansett Bay, Rhode Island.
- (6) Florida State University -- Identification and Analysis of Biological Values of Apalachicola Bay, Florida.
- (7) Gulf Universities Research Corporation -- Case Studies of Estuarine Sedimentation and its Relation to Pollution of the Estuarine Environment [Mississippi Delta; Galveston, Texas; Mobile Bay, Ala.; and Tampa Bay, Fla.]
- (8) Water Resources Research Center of the University of Hawaii -- Study of Estuarine Pollution in the State of Hawaii.
- (9) Institute of Water Resources of the University of Alaska -- Alaska Estuarine Inventory and Cook Inlet Case Study.
- (10) Office of Business Economics, Department of Commerce -- Demographic and Economic Trends Analysis.
- (11) U. S. Geological Survey, Department of the Interior -- Studies of Estuarine Sedimentation.
- (12) U. S. Bureau of Mines, Department of the Interior -- Mining Statistics for Coastal Areas.

- (13) Office of Saline Water -- Relationship of Saline Water Conversion to the Estuarine Environment.
- (14) Texas Water Quality Board -- Socio-economic, Land/ Estuarine Study of Galveston Bay, Texas.
- (15) Bendix Marine Advisors, Inc. -- A Case Study of Estuarine Sedimentation and its Relation to Pollution of the Estuarine Environment [San Diego Bay, Calif.]
- (16) Alpine Geophysical Associates -- A Case Study of Estuarine Sedimentation and its Relation to Pollution of the Estuarine Environment [Raritan Bay, N.J.]
- (17) Ralph Stone and Company, Inc. -- Community Planning in an Estuarine-Oriented Community (San Diego Bay)
- (18) The Franklin Institute -- Selected Abstracts of Storm Water Discharges and Combined Sewer Overflows.
- (19) Infinity, Ltd. -- Case Studies of Pollutational Damage to Estuaries .
- (20) Harold F. Wise & Associates -- A Study of the Effects of Population Trends and Industrial Trends in the Estuarine Zones on Pollution in the Estuaries.
- (21) Battelle Memorial Institute -- Socio- conomic Values of the Nation's Estuarine System.
- (22) James B. Ayres -- A Case-History Study of the Massachusetts Estuarine Management System.

REFERENCE COLLECTION

Finally, the published and unpublished documents perused by the Study, directly and indirectly, probably amount to at least 5,000 reports, conservatively. Of this number approximately 3,000 have been cataloged and indexed as to the general type of material included. For possible future use, the Battelle Memorial Institute developed a computerized information retrieval program for estuarine documents which would allow the automatic retrieval of documents, related to the method used for the quantitative data in the National Estuarine Inventory.





As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States — now and in the future.